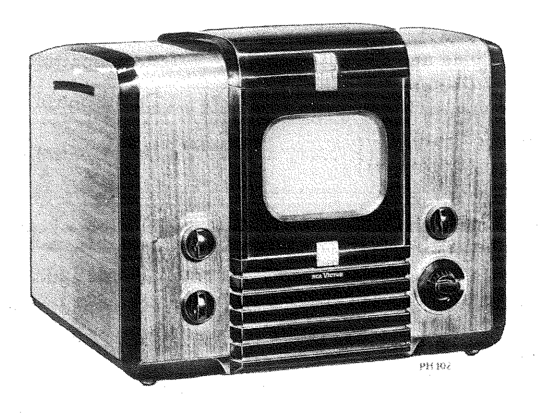




Model 621TS

TELEVISION RECEIVER MODEL 621TS

Chassis No. KCS 21-1—Mfr. No. 274

SERVICE DATA

—1946 No. T2—

RADIO CORPORATION OF AMERICA
RCA VICTOR DIVISION
CAMDEN, N. J., U. S. A.

GENERAL DESCRIPTION

Model 621TS is a twenty-one tube, direct-viewing, table-model Television Receiver having a 7" picture tube (Kinescope). The receiver is complete in one unit and is operated by the use of seven front-panel controls. Features of the receiver include: Full thirteen channel coverage; f-m sound system; improved picture brilliance; two stages of video amplification; stable horizontal and vertical hold controls; improved sync amplifier and separator; and reduced-hazard high-voltage supply.

ELECTRICAL AND MECHANICAL SPECIFICATIONS

PICTURE SIZE........4¼" x 5⅝"—1/16" radius at corner

RADIO FREQUENCY RANGES

Channel Number	Channel Freq. Mc	Picture Carrier Freq. Mc	Sound Carrier Freq. Mc	Receiver R-F Osc. Freq. Mc
1	44-50	45.25	49.75	71
2	54-60	55.25	59.75	81
3	60-66	61.25	65.75	87
4	66-72	67.25	71.75	93
5	76-82	77.25	81.75	103
6	82-88	83.25	87.75	109
7	174-180	175.25	179.75	201
8	180-186	181.25	185.75	207
9	186-192	187.25	191.75	213
10	192-198	193.25	197.75	219
11	198-204	199.25	203.75	225
12	204-210	205.25	209.75	231
13	210-216	211.25	215.75	237

FINE TUNING RANGE

Plus and minus approximately 300 kc on channel 1, and plus and minus approximately 750 kc on channel 13.

POWER-SUPPLY RATING

115 Volts..............................60 cycles, 220 watts

AUDIO POWER-OUTPUT RATING

Undistorted......................................2 watts
Maximum...3 watts

LOUDSPEAKER (92565-1)

Type...................6 x 4 inch Electro Magnet Dynamic
Voice-Coil Impedance...............3.2 ohms at 400 cycles

WEIGHT

Chassis with Tubes in Cabinet......................60 lbs.
Shipping Weight..................................75 lbs.

RECEIVER ANTENNA INPUT IMPEDANCE...............300 ohms balanced

DIMENSIONS (inches)	Length	Height	Depth
Cabinet (Outside)	19	15¼	16¼
Chassis Base (Outside)	15⅜	4⅜	12⅞
Chassis Overall	15⅝	10⅞	15⅞

RCA TUBE COMPLEMENT

	Tube Used	Function
(1)	RCA 6J6	R-F Amplifier
(2)	RCA 6J6	R-F Oscillator
(3)	RCA 6J6	Converter
(4)	RCA 6BA6	1st Sound I-F Amplifier
(5)	RCA 6AU6	2nd Sound I-F Amplifier
(6)	RCA 6AL5*	Sound Discriminator
(7)	RCA 6AT6	1st Audio Amplifier
(8)	RCA 6K6-GT	Audio Output
(9)	RCA 6AG5	1st Picture I-F Amplifier
(10)	RCA 6AG5	2nd Picture I-F Amplifier
(11)	RCA 6AG5	3rd Picture I-F Amplifier
(12)	RCA 6H6	Picture 2nd Detector and Sync Leveler
(13)	RCA 6SN7-GT	1st and 2nd Video Amplifier
(14)	RCA 6SN7-GT	Sync Amplifier and Sync Separator
(15)	RCA 6SN7-GT	Vertical Sweep Oscillator, Discharge and Vertical Sweep Output
(16)	RCA 6SN7-GT	Horizontal Sweep Oscillator and Discharge
(17)	RCA 6BG6-G	Horizontal Sweep Output
(18)	RCA 5V4-G	Damper
(19)	RCA 1B3-GT/8016	High Voltage Rectifier
(20)	RCA 5U4-G	Power Supply Rectifier
(21)	RCA 7DP4	Kinescope

* In some units, an RCA 6AT6 is used.

Specifications continued on page 2

ELECTRICAL AND MECHANICAL SPECIFICATIONS (Continued)

PICTURE INTERMEDIATE FREQUENCIES

Picture Carrier Frequency .... 25.75 Mc
Accompanying Sound Traps .... 21.25 Mc

SOUND INTERMEDIATE FREQUENCIES

Sound Carrier Frequency .... 21.25 Mc
Sound Discriminator Band Width (between peaks) .... 350 Kc

VIDEO RESPONSE .... To 3 Mc

FOCUS .... Electrostatic

SWEEP DEFLECTION .... Magnetic

SCANNING .... Interlaced, 525 line

HORIZONTAL SCANNING FREQUENCY ..... 15,750 cps

VERTICAL SCANNING FREQUENCY .... 60 cps

FRAME FREQUENCY (Picture Repetition Rate) ...... 30 cps

OPERATING CONTROLS (front panel)

Station Selector / Fine Tuning .... Dual Control Knob
Sound Volume and On-Off Switch ...... Single Control Knob
Horizontal (Picture Horizontal Hold) / Vertical (Picture Vertical Hold) ..... Dual Control Knob
Picture (Contrast) / Brightness (Brilliance) .... Dual Control Knob

NON-OPERATING CONTROLS (not including r-f and i-f adjustments)

Horizontal Centering .... rear chassis adjustment
Vertical Centering .... rear chassis adjustment
Width .... rear chassis screwdriver adjustment
Height .... rear chassis adjustment
Horizontal Linearity .... top chassis screwdriver adjustment
Vertical Linearity .... rear chassis adjustment
Horizontal Drive .... rear chassis adjustment
Focus .... rear chassis adjustment
Ion Trap Magnet .... top chassis thumb screw adjustment
Deflection Coil .... top chassis wing nut adjustment

HIGH VOLTAGE WARNING

OPERATION OF THIS RECEIVER OUTSIDE THE CABINET OR WITH THE COVERS REMOVED INVOLVES A SHOCK HAZARD FROM THE RECEIVER POWER SUPPLIES. WORK ON THE RECEIVER SHOULD NOT BE ATTEMPTED BY ANYONE WHO IS NOT THOROUGHLY FAMILIAR WITH THE PRECAUTIONS NECESSARY WHEN WORKING ON HIGH-VOLTAGE EQUIPMENT. DO NOT OPERATE THE RECEIVER WITH THE HIGH-VOLTAGE COMPARTMENT SHIELD REMOVED.

KINESCOPE HANDLING PRECAUTIONS

DO NOT OPEN THE KINESCOPE SHIPPING CARTON, INSTALL, REMOVE, OR HANDLE THE KINESCOPE IN ANY MANNER UNLESS SHATTERPROOF GOGGLES AND HEAVY GLOVES ARE WORN. PEOPLE NOT SO EQUIPPED SHOULD BE KEPT AWAY WHILE HANDLING KINESCOPES. KEEP THE KINESCOPE AWAY FROM THE BODY WHILE HANDLING.

The Kinescope bulb encloses a high vacuum and, due to its large surface area, is subjected to considerable air pressure. For these reasons, Kinescopes must be handled with more care than ordinary receiving tubes.

The large end of the Kinescope bulb—particularly the rim of the viewing surface—must not be struck, scratched, or subjected to more than moderate pressure at any time. In installation, if the tube sticks or fails to slip smoothly through the deflecting yoke, investigate and remove the cause of the trouble. Do not force the tube. Refer to the Receiver Installation section for detailed instructions on Kinescope Installation. All RCA Kinescopes are shipped in special cartons and should be left in the cartons until ready for installation in the receiver. Keep the carton for possible future use.

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RECEIVER OPERATING INSTRUCTIONS

The following adjustments are necessary when turning the receiver on for the first time:

1. Turn the receiver "ON" and advance the SOUND volume control to approximately mid-position.
2. Set the STATION SELECTOR to the desired channel.
3. Turn the PICTURE control fully counterclockwise.
4. Turn the BRIGHTNESS control fully counterclockwise, then clockwise until a faint glow just appears on the screen.
5. Turn the PICTURE control approximately three-fourths clockwise.
6. Adjust the FINE TUNING control for best sound fidelity and the SOUND control for suitable volume.
7. Adjust the VERTICAL hold control until the pattern stops vertical movement. (See Note)
8. Adjust the HORIZONTAL hold control until a single stationary image of the pattern or picture appears on the screen. Then make careful adjustment to eliminate bend, distortion, or "tear away" at top of picture. (See Note)

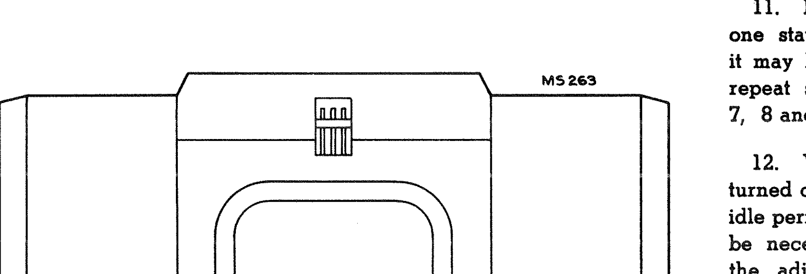


Figure 1—Receiver Operating Controls

9. Adjust the PICTURE control for suitable picture contrast. (See Note).
10. After the receiver has been on for some time, it may be necessary to readjust the FINE TUNING control slightly for improved sound fidelity.
11. In switching from one station to another, it may be necessary to repeat steps number 6, 7, 8 and 9.
12. When the set is turned on again after an idle period, it should not be necessary to repeat the adjustments if the positions of the controls have not been changed. If any adjustment is necessary, step number 6 is generally sufficient.
13. If the positions of the controls have been changed, it may be necessary to repeat steps number 1 through 9.

NOTE: See page 13 for effects of improper adjustment of controls, and some conditions of reception.

ELECTRICAL AND MECHANICAL SPECIFICATIONS (Continued)

PICTURE INTERMEDIATE FREQUENCIES

Picture Carrier Frequency........................25.75 Mc
Accompanying Sound Traps......................21.25 Mc

SOUND INTERMEDIATE FREQUENCIES

Sound Carrier Frequency.........................21.25 Mc
Sound Discriminator Band Width (between peaks)....350 Kc

VIDEO RESPONSE.............................To 3 Mc

FOCUS.....................................Electrostatic

SWEEP DEFLECTION..........................Magnetic

SCANNING..........................Interlaced, 525 line

HORIZONTAL SCANNING FREQUENCY.....15,750 cps

VERTICAL SCANNING FREQUENCY............60 cps

FRAME FREQUENCY (Picture Repetition Rate)......30 cps

OPERATING CONTROLS (front panel)

Station Selector / Fine Tuning ....Dual Control Knob
Sound Volume and On-Off Switch ...... Single Control Knob
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Picture (Contrast) / Brightness (Brilliance) ....Dual Control Knob

NON-OPERATING CONTROLS (not including r-f and i-f adjustments)

Horizontal Centering................rear chassis adjustment
Vertical Centering..................rear chassis adjustment
Width........ ....rear chassis screwdriver adjustment
Height............................rear chassis adjustment
Horizontal Linearity.......top chassis screwdriver adjustment
Vertical Linearity..................rear chassis adjustment
Horizontal Drive....................rear chassis adjustment
Focus.............................rear chassis adjustment
Ion Trap Magnet.......top chassis thumb screw adjustment
Deflection Coil..............top chassis wing nut adjustment

HIGH VOLTAGE WARNING

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6. Adjust the FINE TUNING control for best sound fidelity and the SOUND control for suitable volume.

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9. Adjust the PICTURE control for suitable picture contrast. (See Note).

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11. In switching from one station to another, it may be necessary to repeat steps number 6, 7, 8 and 9.

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13. If the positions of the controls have been changed, it may be necessary to repeat steps number 1 through 9.

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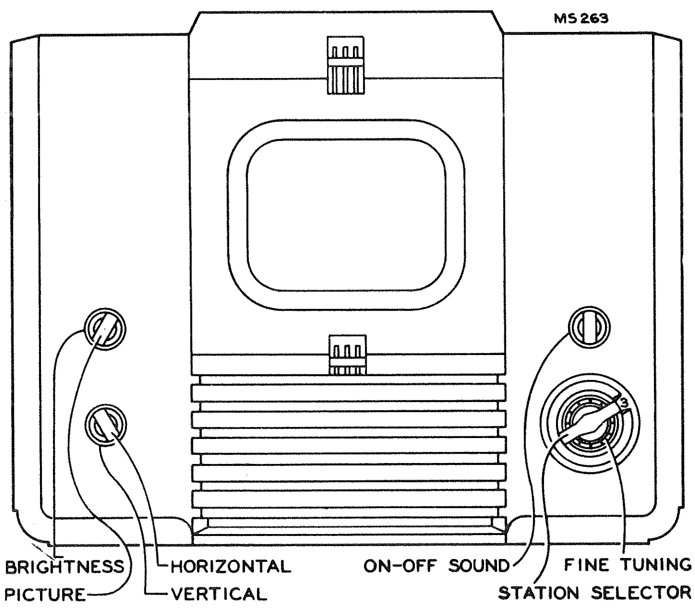


Figure 1—Receiver Operating Controls

It is advisable that the reader be familiar with a recent standard textbook of television principles in order to understand the receiver circuits and their functions. Such a knowledge is assumed for the purpose of this publication. The discussions which follow will not dwell on the operation of conventional circuits which have been used in previous receivers and which should be well known. In general, the circuits discussed will be only those that are new to the field.

For ease of understanding the basic operation of the receiver, an 11-unit block diagram is shown in Figure 2. The circuit description will follow the numerical order of these blocks in order to follow a signal logically through the set.

R-F UNIT (block No. 1)—The r-f unit is a separate subchassis of the receiver. On this subchassis are the r-f amplifier, converter, oscillator, fine tuning control, channel switch, converter transformer, and the r-f, converter, and oscillator coils and all their tuning adjustments. The unit provides operation on all thirteen of the present television channels. It functions to select and amplify the desired picture and sound carriers, and converts to provide at the converter plate a picture i-f carrier of 25.75 mc and a sound i-f carrier of 21.25 mc.

R-F Amplifier—Referring to the Schematic Diagram (page 34), T1 is a center-tapped coil used to short circuit low-frequency signals picked up by the antenna. These signals would otherwise be applied directly to the control grids of the 6J6 r-f amplifier, V1. C1 and C2 are antenna-isolating capacitors. The d-c return for the grids of V1 is through R3 and R13, which also properly terminate the 300-ohm antenna transmission line. C3 and C4 are neutralizing capacitors necessary to counteract the grid-to-plate capacitance of the triode r-f amplifier.

In the plate circuit of the r-f amplifier are a series of inductances; L1 to L25 and L2 to L26 inclusive. These inductances may be considered as a quarter-wave section of balanced transmission line which can be tuned over a band of frequencies by moving a shorting bar along the parallel conductors. Adjustable coils L25 and L26 provide the correct length of line for the thirteenth channel, 210—216 mc. L13 to L23 and L14 to L24 are fixed sections of line which are added to L25 and L26 as the shorting bar is moved progressively down the line. The physical construction of each of these inductances is a small non-adjustable silver strap between the switch contacts. Each strap is cut to represent a six-megacycle change in frequency. In order to make the jump between the lowest high-frequency channel (174-180 mc) and the highest low-frequency channel (82-88 mc), adjustable coils L11 and L12 are inserted. To provide for the remaining five low-frequency channels, L1 to L9 and L2 to L10 are progressively switched in to add the necessary additional inductance.

Coils L1 to L9 and L2 to L10 are unusual in that they are wound in figure-8 fashion on fingers protruding from the switch wafer. This winding form produces a relatively non-critical coil since the coupling between turns is minimized. A maximum amount of wire is used for the small inductance which is required, thus permitting greater accuracy in manufacturing.

Converter—The converter grid line operates in a similar manner and is so arranged on the switch to provide coupling between it and the r-f line. C10, C12, C13, and a link provide additional coupling which is arranged to produce at least a 4-megacycle band pass on each of the channels.

L80 and C14 form a series-resonant circuit used to prevent i-f feedback in the converter by grounding its grids for i-f frequency. They also act as a trap to reject short-wave signals of intermediate frequency which arrive at the converter grid in a push-push manner.

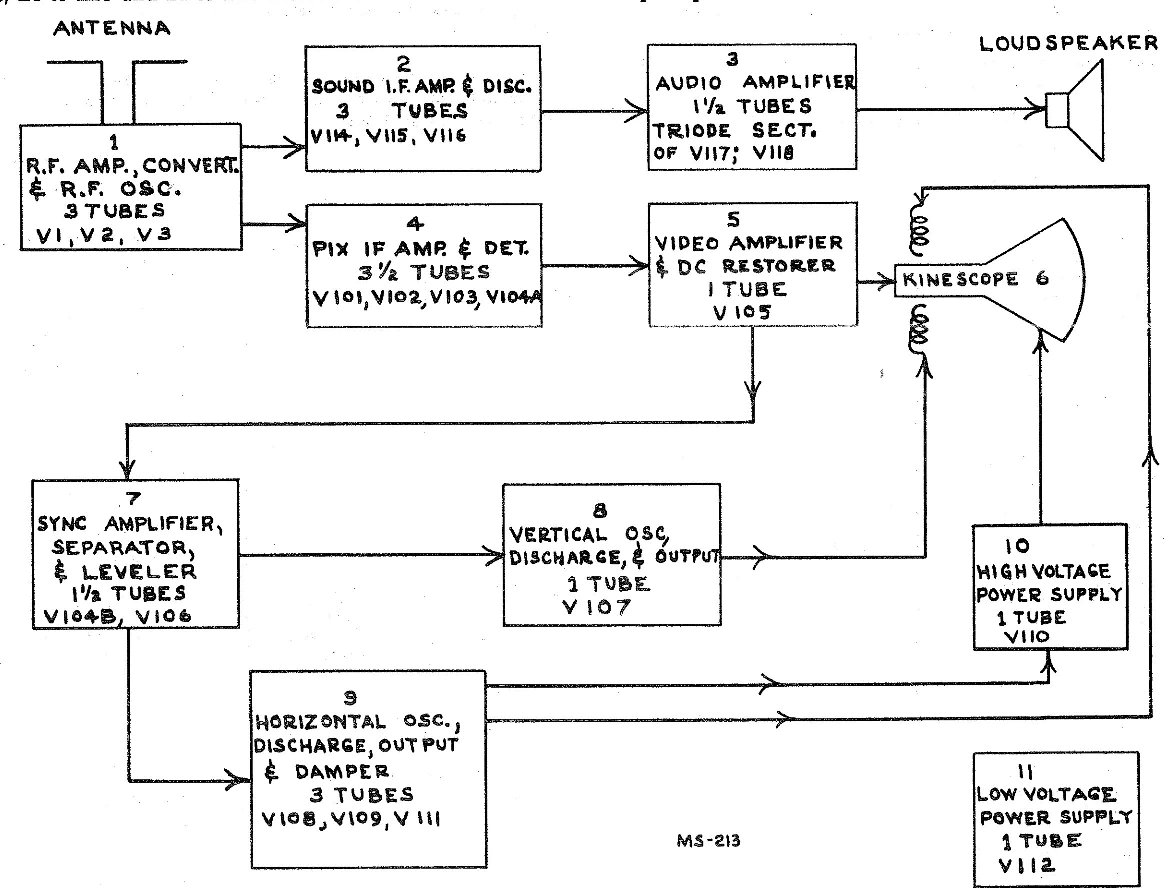


Figure 2—Functional Block Diagram

R-F Oscillator—The oscillator line is similar to the others except that an adjustment is provided for each channel and the low-frequency coils are not figure 8 windings. For tuning each channel, adjustable brass screws are placed in close proximity to the high-frequency tuning straps L66 to L76, and adjustable brass cores are provided for coils L54 to L62. These adjustments are accessible through the front panel of the cabinet when the station-selector escutcheon is removed. Field service adjustments of the r-f oscillator are thus possible on all channels except 6 and 13. If adjustments are necessary on these two channels, the chassis must be removed from the cabinet in order to gain access to the adjusting screws on L63, L64, L77 and L78. The high-frequency adjustments should be made before each lower-frequency adjustment.

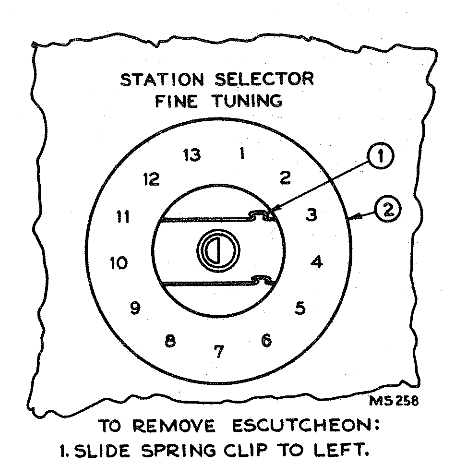


Figure 3—Removal of Station Selector Escutcheon

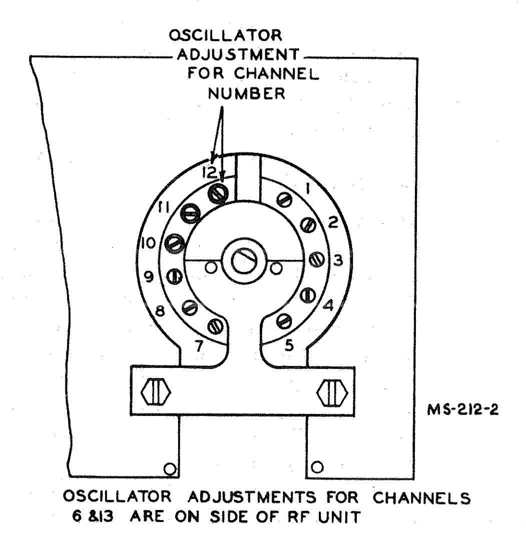


Figure 4—Front Chassis Oscillator Adjustments

C15 is a fine-tuning adjustment which provides plus or minus approximately 300 kc variation of oscillator frequency on channel 1 and plus or minus approximately 750 kc on channel 13. On a few early production units, slightly less range is available.

The location of the oscillator line with respect to the converter grid line is such as to provide some coupling to the converter grids. This coupling is augmented by the link shown on the schematic and provides a reasonably uniform oscillator voltage at the converter grids over the entire tuning range of the unit.

The converter transformer T2 is a combination picture i-f transformer, sound trap, and sound i-f transformer. The converter plate coil is assembled within the structure of a high-Q resonant circuit tuned to the sound i-f frequency. This high-Q circuit absorbs the sound i-f component from the primary. Thus on the T2 primary (from which the picture i-f is fed), the sound carrier is attenuated relative to the picture channel.

SOUND I-F AND DISCRIMINATOR (block No. 2)—A portion of the energy absorbed by the T2 trap circuit is fed to the first sound i-f amplifier. Two stages of amplification are used to provide adequate sensitivity. A conventional discriminator circuit is used to demodulate the signal. The discriminator band width is approximately 350 kc between peaks.

AUDIO AMPLIFIER AND SPEAKER (block No. 3)—The audio amplifier is a conventional system employing the high mu triode section of V117 (6AT6) and a 6K6-GT power output tube which feeds a 6 x 4-inch E.M. dynamic speaker.

PICTURE I-F AND DETECTOR (block No. 4)—The picture i-f amplifier departs considerably from the conventional coupled system. To obtain the necessary wide-band characteristic with adequate gain, three stages of i-f amplification are employed. The converter plate and each successive i-f amplifier utilize one tuned circuit each, and each is tuned to a different frequency. The effective Q of each coil is fixed by the shunt plate load or grid resistor so that the product of the total number of stages produces the desired response curve. Figure 5 shows the relative gains and selectivities of each coil and the approximate shape of the curve of the quadruple combination. This drawing does not take into consideration the effect of the sound traps.

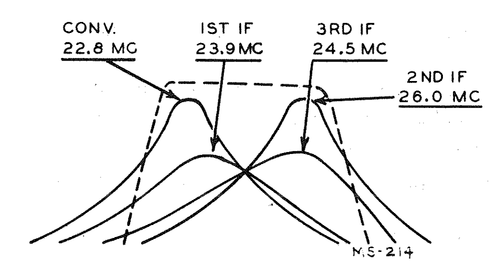


Figure 5—Relative Gains of I-F Transformers

In such a system variations of individual i-f amplifier tube gain do not affect the shape of the overall i-f response curve if the Q's and the center frequencies of the stages remain unchanged. This means that the i-f amplifier tubes are non-critical in replacement because variations in Gm do not affect response shape.

In i-f system alignment, the tuned circuits are peaked to certain specified frequencies with a signal generator. The overall i-f response is then observed with the use of a sweep generator and oscilloscope. Slight deviations from standard circuit Q are compensated for with slight shifts in tuned-circuit center frequency until the desired response curve is obtained. If this response cannot be obtained, the difficulty is likely to be in a component that affects either the frequency or the Q of one or more of the i-f coils.

The response curve does shift slightly as the picture control is varied due to Miller effect. This effect is the change in tube input capacitance as its gain is varied by grid-bias changes.

The change of input capacitance causes a slight detuning of the preceding i-f coil and a small shift in response-curve shape. This effect is slight, however, and when the receiver is aligned with the specified grid bias, no difficulty from this source should be encountered.

Figure 6 shows the relative positions of the picture and sound carriers for channels 2, 3 and 4. If a station on channel 3 is transmitting a picture with video frequencies up to 4 mc, the picture carrier will have upper side band frequencies up to 65.25 mc. The lower side bands are suppressed at the transmitter.

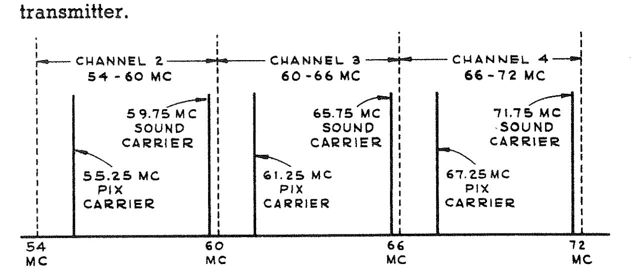


Figure 6—Channel Allocations

With the receiver r-f oscillator operating at a higher frequency than the received carrier, the intermediate frequency relation of picture to sound carrier is reversed as shown in Figure 7.

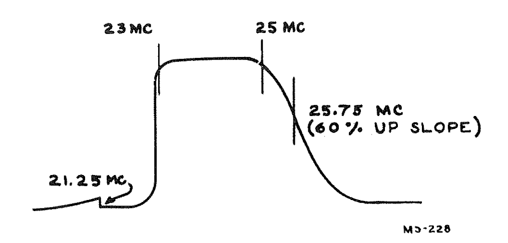


Figure 7—Typical Overall Response Curve

The curve shown is typical of the picture i-f amplifier response. In order to obtain this band-pass characteristic, the picture i-f coils are tuned as follows:

Converter transformer	22.8 mc (T2 primary)
First pix i-f coil	23.9 mc (L101)
Second pix i-f coil	26.0 mc (L102)
Third pix i-f coil	24.5 mc (L103)

Traps—Since it is necessary for the picture i-f amplifier to pass frequencies quite close to the sound carrier frequency, the sound carrier would produce interference in the picture. In order to prevent this interference, traps must be added to the picture i-f amplifier to attenuate the sound carrier. Two traps are provided in the receiver for this purpose.

The first trap (T2 secondary), located on the r-f unit, is an absorption circuit which is tuned to the accompanying sound channel frequency of 21.25 mc. The second trap (T101) is a cathode-coupled circuit, located in the cathode return of the third picture i-f tube V103. The coil in series with the cathode bypass capacitor C110 forms a series-resonant circuit at the frequency to which the plate coil L102 of V102 is tuned (26.0 mc). This provides a low impedance in the cathode circuit of V103 at this frequency and permits the tube to operate at a gain. However, at the resonant frequency (21.25 mc) of the secondary of T101, tuned by C109 and the adjustable core, a high impedance is reflected into the cathode circuit. Thus, the gain of the tube at this frequency, (21.25 mc) is reduced by degeneration. The rejection at 21.25 mc with this circuit is limited to the gain of the tube.

No adjacent channel sound or picture traps are provided in this receiver.

Picture Second Detector—The detector is a conventional half-wave rectifier connected to produce a video signal of the proper polarity. One section of a 6H6 dual-diode tube (V104A) is used for this purpose.

Picture Control—The picture (or contrast) control (R108) varies the bias on the r-f amplifier and the first and second i-f amplifier control grids. It is, in effect, a manual sensitivity control operated to provide the correct video output level from the second detector.

VIDEO AMPLIFIER AND D-C RESTORER (block No. 5)—The function of this section of the receiver is to amplify the video output of the second detector. Two amplifier stages are employed by using a 6SN7-GT dual-triode tube. Peaking coils are used in the picture detector output and in the last video amplifier plate circuit in order to overcome the circuit and tube capacity effects which tend to reduce the gain of each stage at the higher frequencies. Peaking also provides a sharp cut-off at the high end of the pass band. The gain from the first video grid to output plate is 20X and the frequency response extends to 3 mc.

Interference Saturation Circuit—Since the synchronizing pulse is "blacker than black" and "black" information must drive the Kinescope grid toward cutoff, the video signal polarity must be such that the sync is negative when applied to the Kinescope grid. It is therefore obvious that for the two-stage video amplifier used, the sync pulse from the second detector must also be negative at the first video amplifier grid. The first stage is designed so that with a normal signal input level at its grid, the tube will be working over most of its operating range. Then any large interference signal above sync will drive the grid to cutoff and the interference will be limited. The signal to interference ratio is thus effectively improved.

D-C Restorer—Since the video amplifier is an a-c amplifier, the d-c component of the video signal that represents the average illumination of the original scene will not be passed. Unless this d-c component is restored, difficulty will be experienced in maintaining proper scene illumination. For any given scene, this average illumination could be set properly by the brightness control. However, a change of scene would probably necessitate resetting this control.

The d-c restorer accomplishes this setting automatically by providing a bias on the kinescope grid that varies with the scene. This variable bias is obtained in the second video stage grid circuit. Each horizontal sync pulse in the composite video signal is in a positive direction as applied to the second video grid and will cause grid current to flow, charging capacitor C115 to approximately the peak value of the pulse. This capacitor, of course, discharges slightly between pulses, the discharge rate being controlled by the value of the grid resistor R121 (1 meg.). Consequently the voltage across C115 varies with the amplitude of the pulses, thus providing the required bias change. With this method of restoring the d-c component, it is necessary that the plate of the video amplifier tube be conductively coupled to the grid of the Kinescope. For a more detailed explanation of the operation of the d-c restorer, see "Practical Television by RCA."

KINESCOPE (block No. 6)—The Kinescope is a 7" tube employing a new type screen material which provides considerably improved picture brilliance. The tube employs magnetic deflection and electrostatic focus. An ion trap magnet is employed to prevent the ion beam from producing a brown spot on the picture screen.

The inside and outside of the flaring portion of the bulb are given a metallic coating. The inner coating, which is the second anode, is connected to the high-voltage supply. The

outer coating is grounded by means of two small springs on the deflection yoke support. The capacity between the two coatings is used as a high voltage filter capacitor.

SYNC AMPLIFIER, SEPARATOR AND LEVELER (block No. 7)—The functions of this system are (1) to amplify the video and synchronizing signal obtained from R125 in the second video stage (V105) plate circuit; (2) to separate the sync pulses from the video signal; (3) to level the pulses before they are applied to the vertical and horizontal sweep oscillators. The pulses are used to trigger these oscillators so that the Kinescope deflection voltages are synchronized with the transmitted signal.

Sync Amplifier (First section of 6SN7-GT, V106)—The first section of V106 is a normal voltage amplifier. Its output is the combined video and sync signal and is applied to the grid of the second section of V106 with the sync peaks in the "positive" direction.

Sync Separator (Second section of V106) and **Sync Leveler** (V104B, second section of 6H6)—The operating voltages applied to the grid and plate of the sync separator section of V106, plus a negative bias obtained from the diode V104B, cause the negative portion of the applied signal to be cut off. Thus, the video and blanking pulse information is removed from the signal appearing at the cathode of the sync separator. The diode (V104B) also levels the line of sync so that each recurring pulse is at a common amplitude.

The sync signal is taken from the cathode because a low-impedance output is obtained (about 200 ohms). This low-impedance output is advantageous since the deflection pulses will not feed back through the tube capacities so readily as would be the case when a triode is used having a plate load for output. The cathode load resistors are R132 and R133 and the sync signal applied to the vertical integrating network is taken from across both resistors. The sync signal applied to the horizontal oscillator (V108) is taken from across R133 only.

Integrating Network—The purpose of this network is to separate the horizontal sync from the vertical sync and to pass the vertical sync pulses to the vertical oscillator.

Since the horizontal sync pulse is of short duration (5 microseconds) and the vertical pulse is of much longer duration (190 microseconds), they can be separated by an r-c filter that is responsive to wave shape. The integrating network, which is such a filter, is composed of R136, R137, R138, C123, C124, and C125. In operation the network can be considered to be a low-pass filter which by-passes the narrow or high-frequency horizontal sync, but which passes the broad or low-frequency vertical sync.

VERTICAL OSCILLATOR, DISCHARGE, AND OUTPUT (block No. 8)—The function of these circuits is to provide a sawtooth of current of the proper frequency to perform the vertical scanning for the Kinescope. To produce such a current in the vertical deflection coil, a somewhat differently shaped voltage wave is required.

Since the vertical trace is slow, requiring 16,000 microseconds, and the vertical deflection coil inductance is small (50 millihenries), the majority of the voltage across the coil during trace is across its resistive component. In order to produce a linear change of current through a resistance, a linear change of voltage is necessary. Retrace, however, must be accomplished within 666 microseconds and therefore requires a much faster rate of change of current through the coil. During this time, the effect of the inductance of the coil becomes appreciable because of the required fast rate of change of current and so a large pulse of voltage must be applied in order to obtain rapid retrace. The composite waveform required to produce a sawtooth of current in the coil is a sawtooth of voltage with a sharp pulse. The 6SN7-GT tube (V107) provides such a voltage.

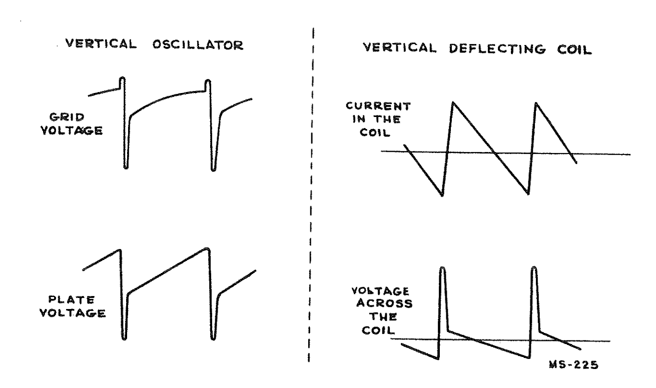


Figure 8—Vertical Sweep Waveforms

Vertical Oscillator and Discharge—The first section of the 6SN7-GT dual triode tube V107, with its associated components, forms a blocking oscillator and discharge circuit. In the absence of the sync pulse input, this oscillator operates at a frequency determined by C126, R143, and R144; R144 (vertical hold control) varies its "free running" frequency. For picture reception, R144 is adjusted so that the free-running period is just slightly longer than the time between standard sync pulses.

In its free-running condition, the wave form of the voltage at the control grid (1) of the tube is a small, positive surge followed by a large negative drop which returns to the positive condition at a relatively slow rate. The positive surge, or pulse, takes about 5% of the time required for the complete cycle.

During the negative part of the cycle, the grid is beyond cut-off and the discharge capacitor, C130, charges through resistors R139, R141, R142 and R149. When the grid reaches a voltage that permits plate to cathode conduction, C130 discharges through T102 secondary, R149, and the tube. The discharge current of C130 builds up a magnetic field in T102 that in turn induces a positive voltage at the grid (1) of the tube. This positive voltage on the grid lowers the plate resistance of the tube which allows C130 to discharge more rapidly. This process builds up very quickly until C130 is nearly discharged. The magnetic field in T102 then collapses and drives the grid negative. The charge placed on C126 due to grid conduction during the positive pulse now holds the grid negative. As the charge on C126 leaks off through R143, R144, etc., the grid slowly becomes less negative and will eventually reach the point that again permits plate to cathode conduction. This process is repeated in the absence of the incoming sync pulse.

During picture reception, the 60 cycle vertical synchronizing pulse from the integrating network is applied to the grid of the vertical oscillator tube. This incoming sync pulse reaches the grid just before the tube would "trip" in its free running cycle. The magnitude of the sync pulse is sufficient to drive the tube tc conduction. Thus, the incoming sync trips the oscillator just slightly before it would have tripped itself and in this manner the incoming sync maintains control of vertical scanning. As previously mentioned, the vertical hold control (R144) is adjusted so that the free-running period is just slightly longer than the time between vertical sync pulses.

On the plate (2) of V107, a sawtooth of voltage appears due to the slow charging and rapid discharging of C130. A sharp negative pulse also occurs during the discharge period. (See Figure 8.) This pulse appears because of the peaking action of R149 and C130. When the tube is conducting, the plate voltage drops almost to cathode potential. C130 discharges during this time. However, since the conduction time is short, C130 cannot be completely discharged due to the time constant of R149 in series with C130. Then when the tube becomes non-conducting, the plate voltage does not have to rise slowly from cathode potential but instead rises immediately to an appreciable value due to the charge that remains on C130. The plate voltage then slowly rises from this value as C130 charges through R139, R141, R142, and R149. Adjustment of the height control R141 varies the amplitude of the sawtooth voltage on the plate by controlling the rate at which C130 can charge.

The voltage present on the plate (2) is of the basic shape required to produce a sawtooth of current in the vertical deflection coil; however, it must be amplified in order to produce the required amount of power.

Vertical Output—The second section of the 6SN7-GT tube (V107) is used for the vertical output stage. The vertical output transformer T103 matches the impedance of the vertical deflection coils to the plate impedance of the tube.

R148 is provided as a linearity control. The grid-voltage plate-current curve of this tube is not a straight line over its entire range; therefore the effect of adjustments of R148 is to produce variations in shape of the sawtooth by shifting the operating point of the tube to different points along the curve. Since the slope of the curve varies at these different points and thus varies the effective gain of the tube, adjustments of linearity affect picture height and such adjustments must be accompanied by readjustments of the height control R141. Adjustments of the height control affect the shape of the sawtooth voltage on the plate (2) of the oscillator section of this tube so that adjustments of height must be accompanied by readjustments of linearity.

HORIZONTAL OSCILLATOR, DISCHARGE, OUTPUT, AND DAMPER (block No. 9)—The purpose of these circuits is to produce the sawtooth of current in the deflection coils necessary to provide horizontal scanning for the Kinescope.

Horizontal Oscillator and Discharge—The proper waveform is generated by the 6SN7-GT tube V108 and its associated components. The operation is similar to that in the vertical circuits described above except that the first section of the tube is used as the oscillator and the second section as the discharge circuit that produces the sawtooth waveform necessary for horizontal deflection of the Kinescope beam.

In the absence of the sync pulse input, the oscillator section of the tube operates at a frequency determined by C133, R155, R156, and R158. The free-running frequency is controlled by the setting of R156 (horizontal hold control). As the grids of both sections are connected together, the grid (4) of the discharge section becomes positive simultaneously with the oscillator grid and both sections conduct in unison.

During picture reception, the horizontal synchronizing pulse obtained from across R133 in the cathode circuit of the sync separator section of V106 is of sufficient magnitude to trip the oscillator before capacitor C133 in the oscillator grid circuit has discharged through R155, R156, and R158 to a value that permits the tube to conduct in its free-running state. Thus, as in the vertical circuits, the synchronizing pulse maintains control of the oscillator frequency when the horizontal hold control (R156) is adjusted so that the free-running time is slightly longer than the time between the horizontal sync pulses.

The discharge section of V109 produces the required sawtooth due to the slow charging and rapid discharging of capacitor C136. During the time of the prolonged negative portion of the oscillator pulse, when the tube is not conducting, C136 charges through R159, C135, R161 (horizontal drive control), and R188. During the short conduction period of the tube, the capacitor is discharged.

The peaking action described in the vertical discharge description is obtained by R161 (horizontal drive control) and R188 in conjunction with C136.

Horizontal Output and Damper—The operation of these two circuits is so interconnected that they must necessarily be discussed simultaneously. The function of the output tube V109 is to supply sufficient current of the proper wave form to the horizontal deflection coils in order to provide horizontal scanning for the Kinescope. The function of the damper tube V111 is to stop oscillation of certain components at certain times and thus help provide a linear trace. Other functions of these circuits include the utilization of energy stored in the horizontal deflection coil to furnish retrace and Kinescope high voltage. The damper circuit also recovers some of the energy from the yoke kick-back and uses it to help supply the plate power requirements of the output tube.

In operation, the visible portion of the horizontal trace is approximately 53 microseconds in duration. Although the inductance of the horizontal deflection coil is in the order of only 8 millihenries, the reactance of the coil predominates over the coil's resistance at the horizontal scanning frequency. This is a different case than that encountered in the vertical deflection system and so a different method of operation must be employed.

Horizontal blanking is approximately 10 microseconds in duration. During this time, the Kinescope beam must be returned to the left side of the tube, and the trace must be started and made linear. To accomplish all this within the horizontal blanking time, only 7 microseconds can be allowed for the return trace. In order to obtain such rapid retrace, the horizontal deflection coil, output transformer, and associated circuits are designed to resonate at a frequency such that one half-cycle of oscillation at this frequency will occur in the 7 microseconds retrace time limit. This represents a frequency of approximately 71 kc.

During the latter part of the horizontal trace, the output tube conducts very heavily and builds up a strong magnetic field in the deflection coil and in the output transformer. When the negative pulse from the horizontal oscillator (V108) is applied to the output tube grid, its plate current is suddenly cut off and the magnetic field in the transformer and in the deflection coil begins to collapse at a rate determined by the resonant frequency of the system. Actually the system is shock excited into oscillation. Since the output tube is cut off and since the voltage generated by the collapsing field is negative on the damper tube plate so that it is non-conductive, there is essentially no load on the circuit and it oscillates vigorously for one half-cycle. If the damper tube were not present, the circuit would continue to oscillate as shown in Figure 9, A. This condition however is not permitted. One half-cycle of oscillation is permitted because at the end of such time the current in the deflection coil has reached a maximum in the opposite direction to which it was flowing at the end of the trace period. This reversal of current flow is the requirement for retrace and it is accomplished in the allotted 7 microseconds.

Now that retrace has been completed, the next trace must be started. The energy which was placed in the deflection coil by the output tube in the latter part of the last trace has not been dissipated. During the half-cycle of oscillation retrace was accomplished with very little loss of energy. The field in the coil was merely reversed in polarity. So, at this point, a strong field exists in the deflection coil.

As mentioned previously, if the coil were not damped, it would continue to oscillate at its natural frequency. To prevent this oscillation the damper tube is brought into action. This tube is in a modified damper circuit which is effectively connected across the deflecting coil.

In the oscillating circuit, the current in the deflection coil lags the voltage by approximately 90 degrees (considering 90 degrees as one-quarter cycle of oscillation frequency; i.e., 71 kc) and when the current has reached its maximum negative value, the voltage across the coil, being 90 degrees ahead, has begun to swing positive. When the voltage on the damper tube plate becomes positive with respect to its cathode, the tube begins to conduct heavily. This places such a load across the deflection coil that it cannot oscillate. Instead, the field begins to decay at a rate permitted by the load which the damper tube places on the coil. The circuit constants are such that this decay is linear and at a rate suitable for the visible trace.

If no additional energy were fed into the coil, the field would fall to zero and the Kinescope beam would come to rest in the center of the tube. In such an r-l circuit, as the current approaches its final value, it does not do so linearly but asymptotically as indicated in Figure 9, B. The output tube must therefore begin to supply power to the deflection coil before the energy in the coil is completely dissipated. Figure 9, C shows the curve of the current supplied by the output tube. Although the currents supplied by the output tube and by the decaying field are curved at the cross over point, together they produce a yoke current that is linear. By the time

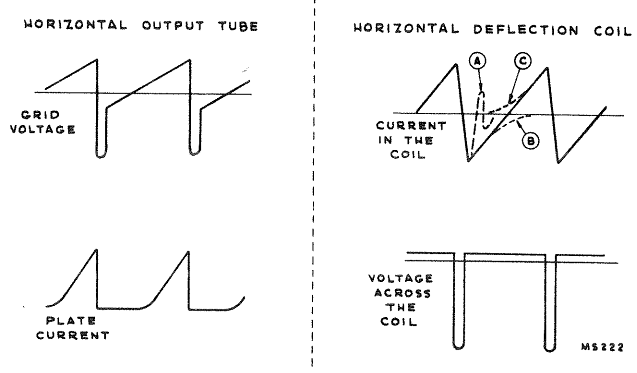


Figure 9—Horizontal Sweep Waveforms

the beam has reached the right side of the Kinescope, the output tube is conducting heavily and has built up a strong field in the transformer and in the coil. At this point, the output tube is again suddenly cut off and the process is repeated.

The 6BG6-G plate voltage is supplied through the 5V4-G damper tube, which is conducting over the major portion of the trace. Capacitors C139 and C140 are charged during this period and this charge is sufficient to supply the 6BG6-G plate when the 5V4-G is not conducting.

The charge is placed on these capacitors by the receiver d-c supply and by the current produced by the collapse of the field in the horizontal deflecting coil. The a-c axis of the sweep voltage is approximately 235 volts above ground since the secondary of T105 is connected to the receiver power supply ahead of the centering controls in the +B circuit. The charge placed on the capacitors by the coil kick-back is therefore in addition to that from the d-c supply and thus the capacitors are charged to a voltage greater than the d-c supply. This permits operation of the 6BG6-G at a higher voltage than is obtainable from the receiver power supply and produces an increase in the system efficiency by salvaging energy that would otherwise have been wasted. Plate voltage for the vertical oscillator tube (V107A) and for the horizontal discharge tube (V108B) is also obtained from this source.

Linearity Control—During the trace period, the voltage across L113 varies due to the changing plate current in the horizontal output tube. This varying voltage constitutes an a-c "ripple" on the cathode of the damper tube. L113 and C139 constitute a phase shifting network. By shifting the phase of this ripple, slight variations of linearity are obtained. L113, the horizontal linearity control, is variable and is provided to effect these improvements in linearity. Counterclockwise rotation of the adjustment screw causes the middle of the picture to stretch and the ends to crowd.

Horizontal Drive Control—R161, the horizontal drive control, determines the ratio of peaking to saw-tooth voltage on the grid of the horizontal output tube and thus affects the point on the trace where the tube conducts. Clockwise rotation of the control increases picture width and stretches the left side.

Width Control—L112, the width control, is provided to vary the output and hence the picture width by shunting a portion of the T105 secondary winding. Clockwise rotation of the adjustment increases the picture width and causes the right side of the picture to stretch slightly.

Linearity Adjustment—R165 is a damping resistor inserted to control trace linearity on the left side of the picture. Taps are provided on this resistor by which variations in the yoke and in the output transformer can be compensated for. The proper tap is selected in the factory and probably will not have to be changed in the field.

HIGH-VOLTAGE POWER SUPPLY (block No. 10)—The high-voltage power supply is unusual in that the power is supplied from the energy stored in the deflection inductances during each horizontal scan. When the 6BG6-G plate current is cut off by the incoming signal, a positive pulse appears on the T105 primary due to the collapsing field in the horizontal yoke. This pulse of voltage is stepped up, rectified, filtered and applied to the second anode of the Kinescope. Since the frequency of the supply voltage is high, (15,750 cps), relatively little filter capacity is necessary. Since the filter capacity is small, the stored energy is small, and the high voltage supply is made less dangerous. The filter capacitors are C142 and the capacitor formed by the inner and outer coatings on the Kinescope.

LOW VOLTAGE POWER SUPPLY (block No. 11)—The low voltage power supply provides the filament and plate voltages for the receiver. The unit is conventional, and employs a 5U4-G rectifier tube to supply 325 volts d-c at approximately 225 ma. The speaker field is used as the filter choke.

RECEIVER LOCATION—The owner should be advised of the importance of placing the receiver in the proper location in the room.

The location should be chosen—

—Away from bright windows and so that no bright light will fall directly on the screen. (Some illumination in the room is desirable, however.)

—To give easy access for operation and comfortable viewing.

—To permit convenient connection to the antenna.

—Convenient to an electrical outlet.

—To allow adequate ventilation.

VENTILATION CAUTION—The receiver is provided with adequate ventilation holes in the bottom, back, top, and sides of the cabinet. Care should be taken not to allow these holes to be covered or ventilation to be impeded in any way.

RECEIVER SUPPORT CAUTION—The complete receiver weighs approximately 60 pounds. This represents a considerably greater load than can usually be placed on the average small table. Only a very sturdy table should be used to support the receiver.

Due to the weight of the receiver, the cabinet should not be dragged or slid across the supporting table as damage to the table finish may result.

ANTENNAS—The finest television receiver built may be said to be only as good as the antenna design and installation. It is therefore important to use a correctly designed antenna, and to use care in its installation.

RCA Television Antennas, stock No. 225 and No. 226, are designed for reception on all thirteen television channels. These antennas use the 300-ohm RCA "Bright Picture" television transmission line. Installation personnel are cautioned not to make any changes in the antenna or to substitute other types of transmission line as such changes may result in unsatisfactory picture reproduction.

The stock No. 226 antenna is bi-directional on channels one through six (44 to 88 Mc). When used on these channels, the maximum signal is obtained when the antenna rods are broadside to the transmitting antenna.

The stock No. 225 antenna with reflector is uni-directional on channels one through six. When used on these channels, the maximum signal is obtained when the antenna rods are broadside to the transmitting antenna, with the antenna element between the reflector and the transmitting antenna.

When operated on channels seven through thirteen, (174 to 216 Mc), both types of antennas have side lobes. On these channels, the maximum signal will be obtained when the antenna is rotated approximately 35 degrees in either direction from a position broadside to the transmitting antenna.

In general, the stock No. 225 antenna should be used if reflections are encountered, if the signal strength is weak, or if the receiving location is noisy. If these conditions are not encountered, the stock No. 226 antenna will probably be satisfactory.

In most cases, the antenna should not be installed permanently until the quality of the picture reception has been observed on a television receiver. A temporary transmission line can be run between the receiver and the antenna, with sufficient slack to permit moving the antenna. Then, with a telephone system connecting an observer at the receiver with an assistant at the antenna, the antenna can be positioned to give the most satisfactory results on the received signal. A shift of direction or of a few feet in antenna position may effect a considerable difference in picture reception.

REFLECTIONS—If reflections are encountered, it may be possible to eliminate them by rotation of the antenna.

Occasionally reflections may occur that are not noticeable as reflections but that will instead cause a loss of definition in the picture.

Under certain extremely unusual conditions, it may be possible to rotate or position the antenna so that it receives the cleanest picture over a reflected path. If such is the case, the antenna should be so positioned. However, such a position may give variable results as the nature of reflecting surfaces may vary with weather conditions. Wet surfaces have been known to have different reflecting characteristics than dry surfaces.

INTERFERENCE—Auto ignition, street cars, electrical machinery, and diathermy apparatus may cause interference which spoils the picture. Whenever possible, the antenna location should be removed as far as possible from highways, hospitals, doctors' offices, and similar sources of interference. In mounting the antenna, care must be taken to keep the antenna rods at least ¼ wave length (at least 6 feet) away from other antennas, metal roofs, gutters, or other metal objects.

LIGHTNING ARRESTOR—The lightning arrestor contained in the antenna kit should be installed in accordance with the instructions. The mast used to mount the antenna should be provided with a direct ground.

INFORMATION REFERENCES—In short, a television receiving antenna and its installation must conform to much higher standards than an antenna for reception of International Short Wave and Standard Broadcast signals. For further information on antennas and antenna installation see the RCA Booklet entitled "Practical Television by RCA," and also the specific instructions accompanying the RCA Television Antenna.

RECEIVER HANDLING PRECAUTION—The 621TS Receiver weighs approximately 60 pounds and therefore should always be picked up by the bottom of the cabinet since lifting by the top might tend to strain the cabinet structure.

SETTING UP RECEIVER—The receiver is shipped with all tubes in their sockets except the 7DP4 Kinescope. The Kinescope is shipped in a special carton and should not be unpacked until ready for installation.

Remove the front panel of the receiver cabinet as indicated in Figure 10, and then the perforated metal back cover.

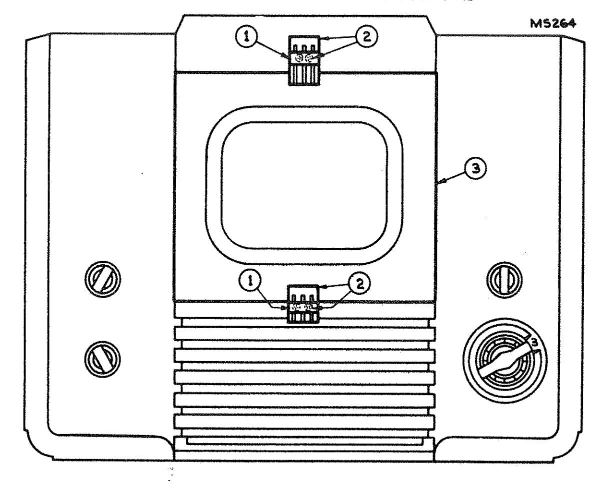


Figure 10—Removal of Cabinet Front Panel

Remove the protective cardboard from the 5U4-G rectifier tube.

Make sure that all tubes are in place and firmly seated in their sockets.

Loosen the two Kinescope cushion adjustment wing screws and slide the cushion toward the rear of the chassis.

Loosen the deflection yoke adjustment and slide the yoke toward the rear of the chassis.

(See Figure 11 for the location of the cushion and yoke adjustments).

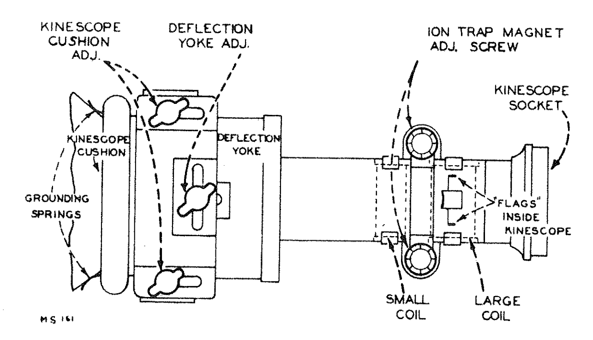


Figure 11—Cushion, Yoke, and Ion Trap Magnet Adjustments

Loosen the two lower Kinescope face centering supports, and set them at approximately mid-position. See Figure 12 for location of the supports and their adjustment screws.

Loosen the ion trap magnet adjustment thumb screws.

KINESCOPE HANDLING PRECAUTION—Do not open the Kinescope shipping carton, install, remove, or handle the Kinescope in any manner, unless shatterproof goggles and heavy gloves are worn. People not so equipped should be kept away while handling the Kinescope. Keep the Kinescope away from the body while handling. The shipping carton should be kept for use in case of future moves.

INSTALLATION OF KINESCOPE—The Kinescope second anode contact is a recessed metal well in the side of the bulb. The tube must be installed so that this contact is approximately on top. The finial orientation of the tube will be determined by the position of the Kinescope flags. Looking at the Kinescope gun structure, it will be observed that the second cylinder from the base inside the glass neck is provided with two small metal flags. The Kinescope must be installed so that when looking down on the chassis, the two flags will be seen as shown in Figure 11.

Insert the neck of the Kinescope into the cabinet and through the deflection yoke as shown in Figure 12. Before the tube is fully inserted in the cabinet, attach the second anode connector. This is the red lead that terminates in a connector and rubber suction cup.

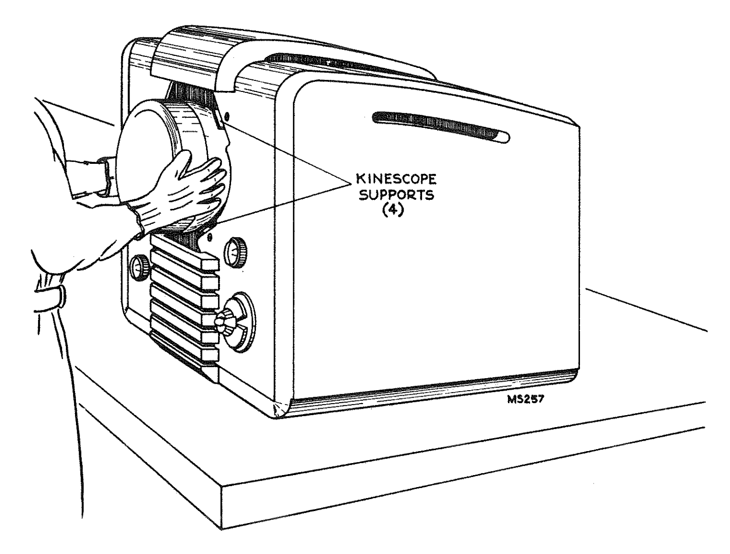


Figure 12—Kinescope Installation

Slip the ion trap magnet with its coils on the neck of the Kinescope with the large coil toward the base of the tube as shown in Figure 11.

Connect the Kinescope socket to the tube base.

Adjust the four Kinescope supports until the face of the Kinescope is in the center of the cabinet opening. Partially tighten the support screws.

Place the front panel temporarily on the cabinet to check the Kinescope centering for proper masking. Readjust the supports as required.

Wipe the Kinescope screen surface and front panel safety glass clean of all dust and finger marks with a soft cloth moistened with "Windex" or similar cleaning agent.

Install the cabinet front in reverse procedure as indicated in Figure 10.

Slip the Kinescope as far forward as possible.

Slide the Kinescope cushion firmly up against the flare of the tube and tighten the adjustment wing screws.

Slide the deflection yoke as far forward as possible and tighten its wing screw.

Attach the knobs to their respective shafts.

The antenna and power connections should now be made.

Turn the power switch to the "on" position, the brightness control fully clockwise, and the picture control counter-clockwise.

ION TRAP MAGNET AND FOCUS ADJUSTMENT—The ion trap rear magnet poles should be approximately over the Kinescope flags as shown in Figure 11. Starting from this position adjust the ion trap magnet by moving it forward, at the same time rotating it slightly around the neck of the Kinescope for the brightest raster on the screen.

If a corner of the raster is shadowed, this indicates that the electron beam is striking the neck of the tube. Rotate the ion trap magnet until the entire raster is visible, approximately centered, and with no shadowed corners.

Tighten the ion trap magnet adjustment thumbscrews sufficiently to hold the trap magnet in this position but still free enough to permit further adjustment of the trap magnet.

Reduce the brightness control setting until the raster is slightly above average brilliance.

Adjust the focus control (R171 on the chassis rear apron) until the line structure of the raster is clearly visible.

Readjust the ion trap magnet for maximum raster brilliance and best focus.

The final touches on this adjustment should be made with the brightness control at the maximum position with which good line focus can be maintained.

Tighten the ion trap magnet adjustment thumb screws.

DEFLECTION YOKE ADJUSTMENT—If the lines of the raster are not horizontal or squared with the picture mask, loosen the yoke adjustment wing screw and rotate the deflection yoke until this condition is obtained. Tighten the wing screw.

PICTURE ADJUSTMENTS—It will now be necessary to obtain a test pattern picture in order to make further adjustments. See steps 2 through 9 of the receiver operating instructions on page 3.

The effects of improper adjustment of the operating controls, and some conditions of reception are shown in Figures 14 to 21 inclusive on page 13.

The following chassis rear apron adjustments may now be necessary. The effects of improper adjustment of these controls are shown in Figures 22 to 29 inclusive, page 14.

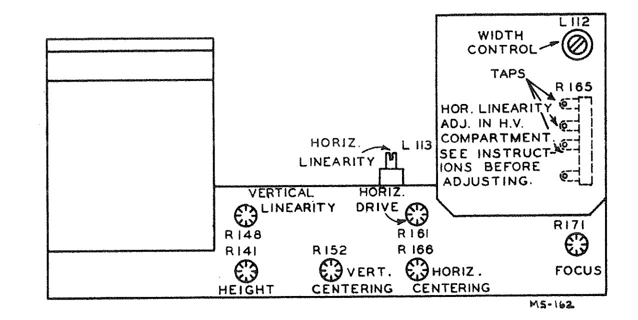


Figure 13—Rear Chassis Adjustments

HEIGHT AND VERTICAL LINEARITY ADJUSTMENTS—Adjust the height control (R141 on chassis rear apron) until the picture fills the mask vertically (4¼ inches). Adjust the vertical linearity control (R148 on rear apron), until the test pattern is symmetrical from top to bottom. Adjustment of either control will require a readjustment of the other. Adjust the vertical centering control (R152 on rear apron) so that the pattern is centered vertically.

WIDTH AND HORIZONTAL LINEARITY ADJUSTMENTS—Turn the horizontal drive control (R161 on rear apron) clockwise as far as possible without causing crowding of the right of the picture. This position provides maximum high voltage for the Kinescope second anode. Adjust the width control (L112 on rear chassis) until the test pattern just fills the mask horizontally (5⅝ inches). Adjust the horizontal linearity control L113 (see Figure 13) until the test pattern is symmetrical left to right. A slight readjustment of the horizontal drive control may be necessary when the linearity control is used. Adjust the horizontal centering control (R166 on rear apron) so that the pattern is centered horizontally.

If repeated adjustments of drive, width, and linearity fail to give proper linearity, it may be necessary to move the tap on R165, which is located in the high voltage compartment. Adjustments of drive, width, and linearity must then be repeated.

Check to see that all cushion, yoke, and ion trap magnet thumb screws are tight. Replace the cabinet back. The receiver may now be put into operation.

CHECK OF R-F OSCILLATOR ADJUSTMENTS—With a crystal-calibrated test oscillator, check to see if the receiver r-f oscillator is adjusted to the proper frequency on all channels when the fine-tuning control is approximately in the center of its range. If not, it must be adjusted by the method outlined on page 23.

Tune in all available Television Stations. Observe the picture for detail, for proper interlacing, and for the presence of reflections. If reflections are encountered, see the section on antennas on page 10.

Effects of Improper Adjustment of Operating Controls, and Some Conditions of Reception.

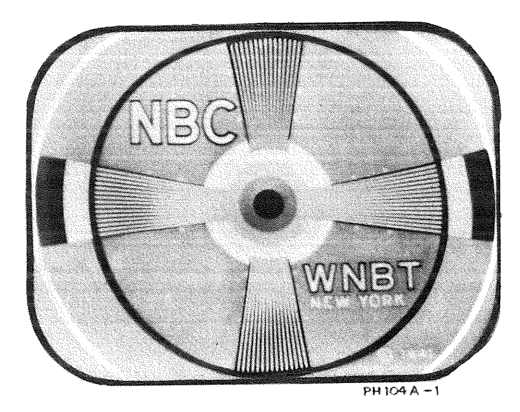


Figure 14—Normal Picture

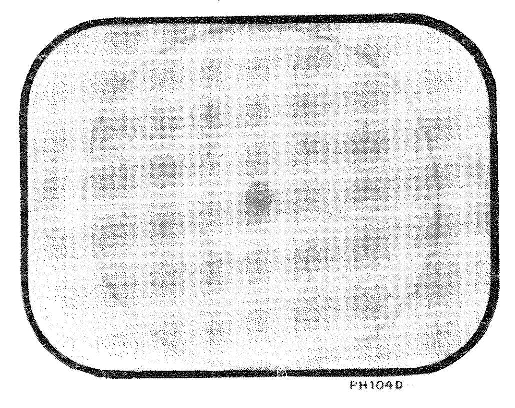


Figure 15—Brightness Control Misadjusted

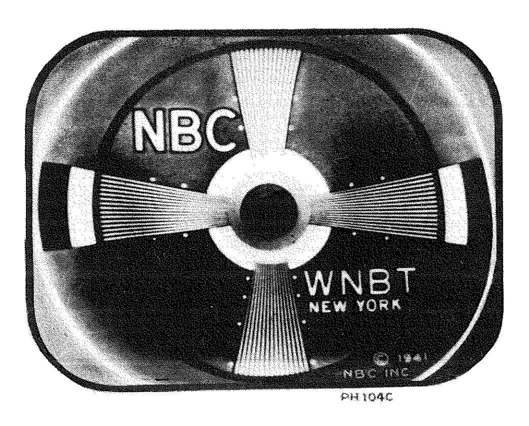


Figure 16—Picture Control Misadjusted

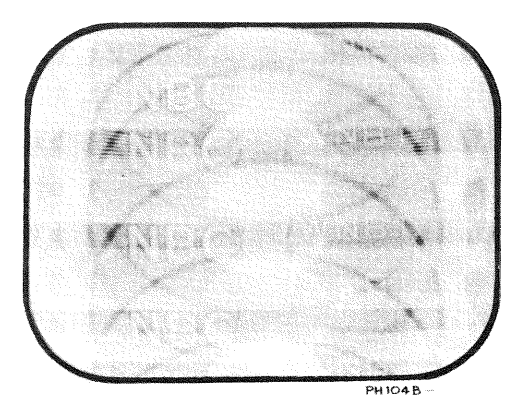


Figure 17—Vertical Control Misadjusted

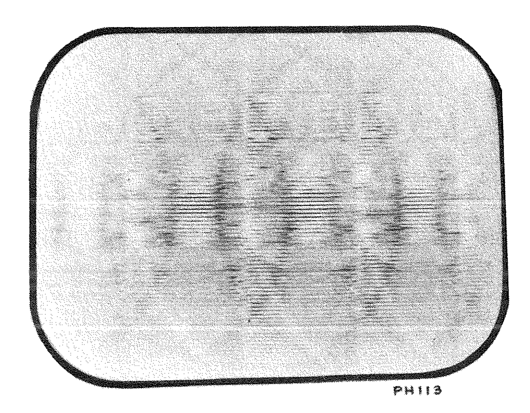


Figure 18—Horizontal Control Misadjusted

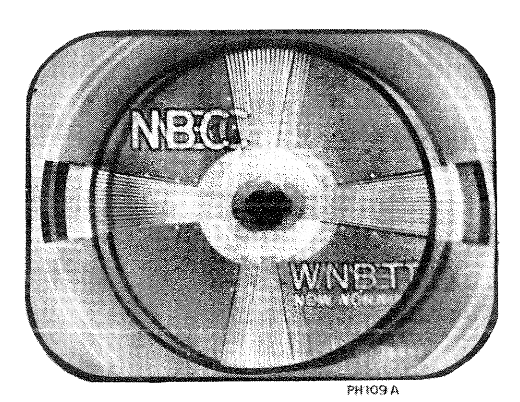


Figure 19—Reflections

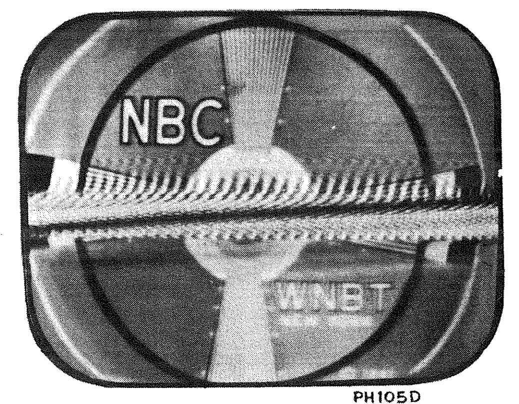


Figure 20—Diathermy Interference

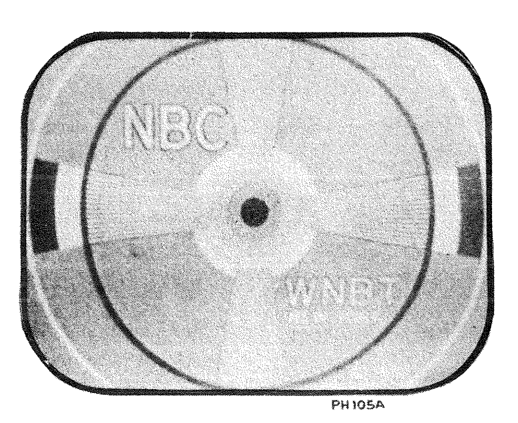


Figure 21—Weak Signal

Effects of Improper Adjustment of Rear Chassis Controls.

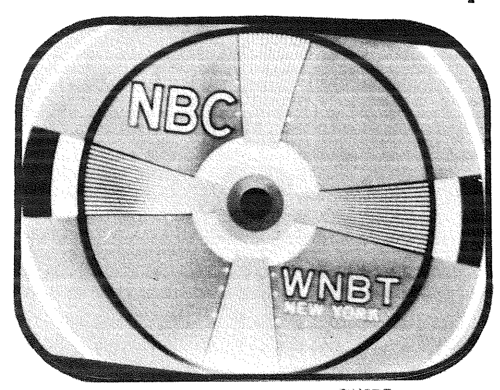


Figure 22—Deflection Yoke Rotated

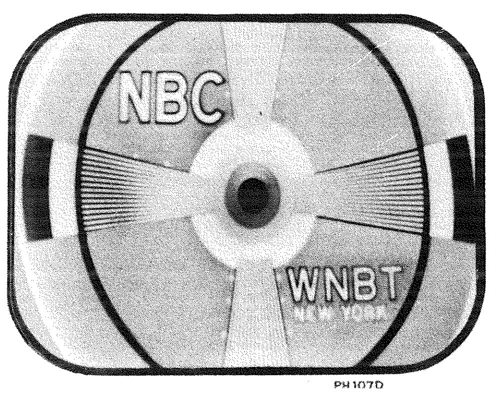


Figure 23—Height Control Misadjusted

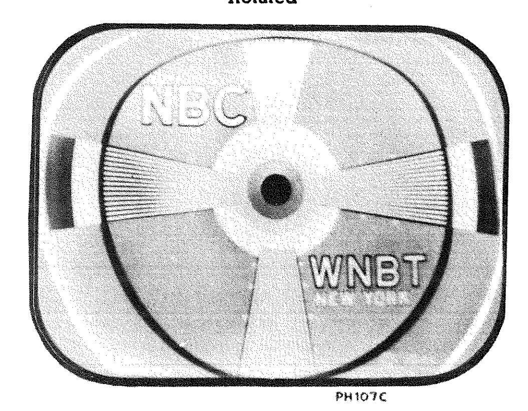


Figure 24—Vertical Linearity Control Misadjusted

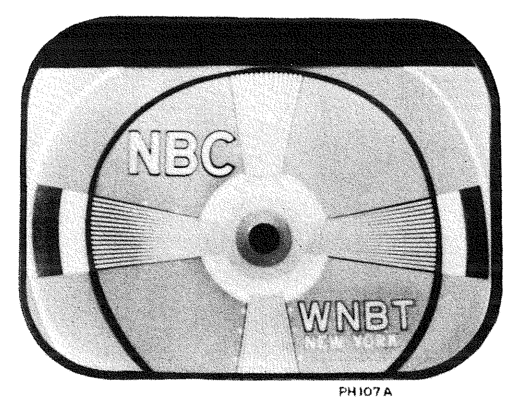


Figure 25—Vertical Centering Control Misadjusted

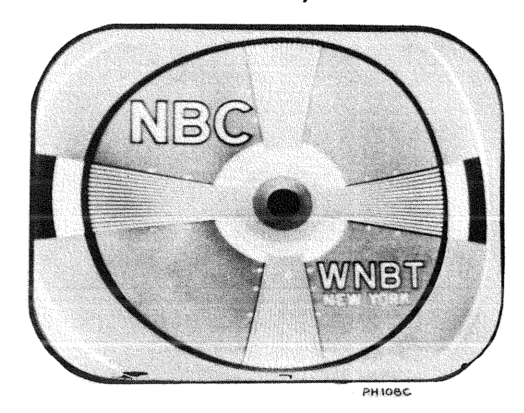


Figure 26—Horizontal Drive Control Misadjusted

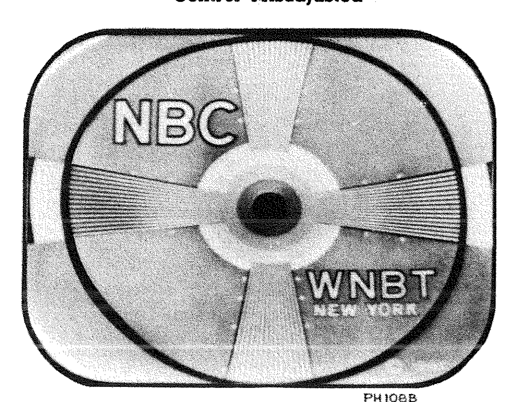


Figure 27—Width Control Misadjusted

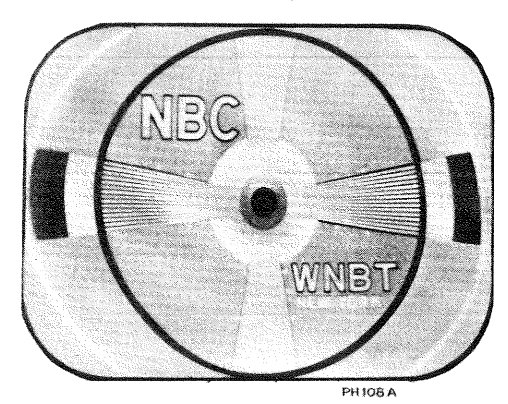


Figure 28—Horizontal Linearity Control Misadjusted (Picture Cramped in Middle)

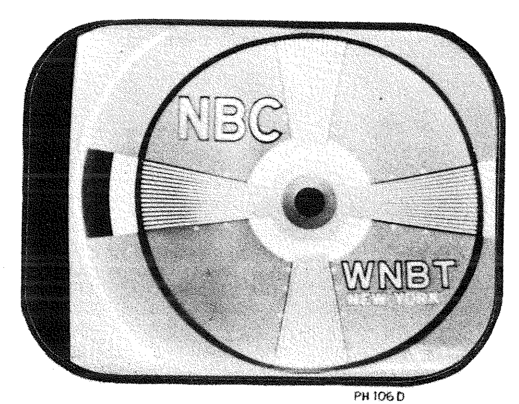


Figure 29—Horizontal Centering Control Misadjusted

TEST EQUIPMENT—To service this receiver properly, it is recommended that the following test equipment be available:

R-F Sweep Generator meeting the following requirements:

(a) Frequency Ranges:
18 to 30 mc, 1 mc sweep width
40 to 90 mc, 10 mc sweep width
170 to 225 mc, 10 mc sweep width

(b) Output adjustable with at least 1 volt maximum.

(c) Output constant on all ranges.

(d) "Flat" output on all attenuator positions.

Cathode-ray Oscilloscope, preferably one with a wide band vertical deflection and input calibrating source.

Signal Generator to provide the following frequencies: (Output on these ranges should be adjustable and at least 1 volt maximum.)

(a) Intermediate frequencies:
21.25 mc sound i-f and sound traps
22.8 mc converter transformer
23.9 mc first picture i-f transformer
24.5 mc third picture i-f coil
26.0 mc second picture i-f coil

(b) Radio frequencies:

Channel Number	Picture Carrier Freq. Mc	Sound Carrier Freq. Mc
1	45.25	49.75
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

Heterodyne Frequency Meter with crystal calibrator if the signal generator is not crystal controlled.

Electronic Voltmeter of "Junior VoltOhmyst type" and a high voltage probe for use with this meter to permit measurements up to 10 kv.

SERVICE PRECAUTIONS—Cutouts in the bottom of the cabinet make it possible to do some of the servicing of the receiver without removing the chassis. If the receiver is serviced in the cabinet, a soft pad should be placed under the cabinet when it is inverted, in order to avoid scratching the surface. In manufacture, the cabinet receives a Class 1 rub finish and every effort should be made to preserve that finish. The receiver handling precaution on page 11 should also be observed.

If necessary to remove the chassis from cabinet, the Kinescope must first be removed. See Figures 10, 11, and 12. If possible, the chassis should then be serviced without the Kinescope. However, if it is necessary to view the raster during servicing, the Kinescope should be inserted only after the chassis is turned on end. The Kinescope should never be allowed to support its weight by resting in the deflecting yoke. A bracket should be used to support the tube at its viewing screen.

By turning the chassis on end with the power transformer "up", all adjustments will be made conveniently available. Since this is the only safe position in which the chassis will rest and still leave adjustments accessible, the trimmer location drawings are oriented similarly for ease of use.

CAUTION: Do not permit the Kinescope second-anode lead to become "shorted" to the chassis. To do so will cause a considerable overload on the high-voltage filter resistor R167.

ADJUSTMENTS REQUIRED—Normally, only the r-f oscillator line will require the attention of the service technician. All other circuits are either broad or very stable and hence will seldom require readjustment.

The r-f oscillator-line adjustment is critical and may be affected by a tube change. The line can be adjusted to the proper frequency on channel 13 with practically any 6J6 tube in the socket. However, it may not then be possible to adjust the line to frequency in all of channels 7, 8, 9, 10, 11, and 12. For an oscillator tube to be satisfactory, it should be possible to adjust the line to proper frequency with the fine-tuning control in the middle of its range. It may therefore be necessary to select a tube for the oscillator socket. In replacing, if the old tube can be matched for frequency by trying several new ones, this practice is recommended. At best, however, it will probably be necessary to realign the oscillator line completely after changing the tube.

Tubes which cannot be used as an oscillator may work satisfactorily as an r-f amplifier or a converter.

The detailed alignment procedure which follows is intended primarily as a discussion of the method used, precautions to be taken, and the reasons for these precautions. Then, for more convenient reference during alignment, a tabulation of the method is given. All the information necessary for alignment is given in the tables; however, alignment by the tables should not be attempted before reading the detailed instructions.

ORDER OF ALIGNMENT—A complete receiver alignment can be most conveniently performed in the following order:—

Picture i-f traps
Picture i-f plate coils
Sound discriminator
Sound i-f transformers
R-f and converter lines
R-f oscillator line
Converter grid trap (See Note)
Retouch picture i-f plate coils
(Steps 8 to 11 inc., page 20)
Sensitivity check

NOTE: In most receivers, the converter grid trap circuit is of fixed value. Consequently, this adjustment is eliminated.

PICTURE I-F TRAP ADJUSTMENT—Set the voltage on the i-f bias bus to approximately —3 volts. Set the station selector switch to channel 9. Connect the "VoltOhmyst" across the picture second-detector load resistor R118. Connect the output of the signal generator through a 1000 mmf. capacitor directly to the converter grid (either end of R5 to ground). Set the generator to 21.25 mc and set the specified adjustment for minimum indication on the "VoltOhmyst". The generator should be checked against a crystal calibrator to insure that it is exactly on frequency.

21.25 mc—T2 (top)
21.25 mc—T101 (top of chassis)

PICTURE I-F TRANSFORMER ADJUSTMENTS—Set the frequency of the signal generator to each of the following frequencies and peak the specified adjustment for maximum indication on the VoltOhmyst.

22.8 mc—T2 (bottom)
23.9 mc—L101 (top of chassis)
26.0 mc—L102 (top of chassis)
24.5 mc—L103 (top of chassis)

Picture I-F Oscillation—If the receiver is badly misaligned and two or more of the i-f plate coils are tuned to the same frequency, the receiver may fall into i-f oscillation and alignment by the usual method becomes difficult. I-f oscillation shows up as a voltage in excess of 3 volts at the picture detector load resistor. This voltage is unaffected by r-f signal input and sometimes is independent of picture control setting. If such a condition is encountered, a cure may sometimes be effected by adjusting the plate coils approximately to frequency by setting the adjustment stud extensions of T2, L101, L102, and L103 to be approximately equal to those of another receiver known to be in proper alignment. If this does not have the desired effect, oscillation may possibly be stopped by increasing the grid bias with the picture control. If so, the i-f stages may then be aligned by the usual method. Once aligned in this manner, the i-f amplifier will be stable with reduced bias.

If the oscillation cannot be stopped in the above manner, shunt the grids of the first two i-f amplifiers to ground with 1000 mmf. capacitors. Connect the signal generator to the third i-f tube grid and adjust L103 to frequency. Next, remove the shunting capacitor from the second i-f grid, connect the signal generator to this grid and align L102. Then remove the shunting capacitor from the first i-f grid, connect the signal generator to this grid and align L101. Then connect the signal generator to either end of R5, and align T2 to frequency.

If this does not stop the oscillation, the difficulty is not due to i-f misalignment as the i-f section is very stable when properly aligned. Check all i-f by-pass capacitors, i-f coil shunting resistors, tubes, socket voltages, etc.

SOUND DISCRIMINATOR ALIGNMENT—Set the signal generator for approximately 1 volt output at 21.25 mc and connect it to the second sound i-f tube grid. Set the "VoltOhmyst" on the 10 volt scale. Connect the meter in series with a one megohm resistor to the junction of diode resistors R181 and R182 (Terminal "C" of T108). Adjust the primary of T108 (top) for maximum output on the meter.

Connect the "VoltOhmyst" to the discriminator output (Pin 1 of V116). Adjust T108 secondary (bottom). A positive or negative voltage may be produced on the meter dependent upon this adjustment. Obviously to pass from a positive to a negative voltage, the voltage must go through zero. T108 (bottom) should be adjusted so that the meter indicates zero output as the voltage swings from positive to negative. This point will be called discriminator zero-voltage output.

Connect the sweep oscillator to the grid of the second sound i-f amplifier. Adjust the sweep band width to approximately 1 mc with the center frequency at approximately 21.25 mc with an output of approximately 1 volt. Connect the oscilloscope to the discriminator output (Pin 1 of V116). The pattern obtained should be similar to that shown in Figure 35. If not, adjust T108 (top) until the wave form is symmetrical. The peak to peak bandwidth of the discriminator should be approximately 350 kc and the curve should be linear from 21.175 mc to 21.325 mc.

SOUND I-F ALIGNMENT—Connect the sweep oscillator to the top end of the trap winding of T2 (on top of the chassis). Connect the oscilloscope to the second sound i-f grid return (terminal A of T107). Insert a 21.25 mc marker signal from the signal generator into the first sound i-f grid. Adjust T107 (top and bottom) for maximum gain and symmetry about the 21.25 mc marker. The pattern obtained should be similar to that shown in Figure 35.

The output level from the sweep should be set to produce approximately 0.3 volts peak-to-peak at the second sound i-f grid return when the final touches on the above adjustment are made. The sweep output voltage should not exceed the specified values otherwise the response curve will be broadened, permitting slight misadjustment to pass unnoticed and possibly causing distortion on weak signals. The band width at 80% response should be approximately 250 kc.

R-F AND CONVERTER LINE ADJUSTMENT—Connect the r-f sweep oscillator to the receiver antenna terminals. If the sweep oscillator has a 50 ohm single-ended output, balanced output can be obtained by properly terminating the sweep output cable and by connecting a 120 ohm non-inductive resistor in series between the sweep output cable and each receiver antenna terminal. (See Figure 30.) Connect

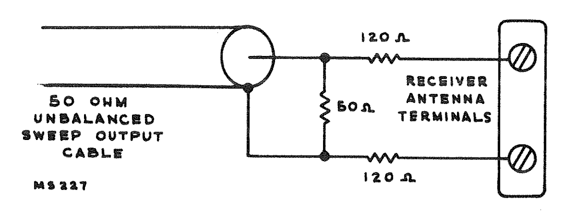


Figure 30—Method of Terminating Sweep Generator

the oscilloscope to the junction of R6 and C14 (in the r-f tuning unit) through a 10,000 ohm resistor. This connection is made on a terminal lug through a hole in the side apron of the chassis, beside the r-f unit. (See Figure 38 for location.) By-pass the first picture i-f grid to ground through a 1000 mmf. capacitor. Keep the leads to this by-pass as short as possible. If this is not done, lead resonance may fall within the r-f range and distort the picture of the r-f response. Set the picture control for approximately −1.5 volts bias on the r-f stage. For convenience check this voltage at the junction of R106 and the "green" shielded lead from the r-f unit. (See Figure 36.) Connect the signal generator loosely to the receiver antenna terminals.

Set the C14 adjustment screw to its approximate normal operating position; 1½ turns out from maximum capacity. If the C14 capacity is less than this, a resonance may be produced in channels 1, 2 or 3. During r-f alignment, such a resonance may show up as a "suck out" in the response curve of one of these channels. Under such conditions the proper response cannot be obtained. With C14 set as specified or in later production receivers in which C14 is fixed, no such difficulty should be experienced.

Since channel 7 has the narrowest response of any of the high-frequency channels, it should be adjusted first. Set the receiver station selector switch to channel 7 (see Figure 38 for shaft flat location versus channel). Set the sweep oscillator to cover channel 7 and insert markers of channel 7 picture carrier and sound carrier; 175.25 mc and 179.75 mc. Adjust L25, L26, L51, and L52 (see Figure 36) for an approximately flat-topped response curve located symmetrically between the markers. Normally this curve appears somewhat overcoupled or double humped with a 10 or 15% peak-to-valley excursion and the markers occur at approximately 90% response. See Figure 37, channel 7. In making these adjustments, the stud extension of all cores should be kept approximately equal.

Check the responses of channels 8 through 13 by switching the receiver station selector switch, sweep oscillator, and marker oscillator to each of these channels and observing the response obtained. See Figure 37 for typical response curves. All of these channels should have the properly shaped response with the markers above 70% response. If the markers do not fall within this requirement on one or more high-frequency channels, since there are no individual channel adjustments, then readjust L25, L26, L51, and L52, possibly compromising some channel slightly in order to get the markers up on other channels. Normally however, no difficulty of this type should be experienced since the higher-frequency channels are comparatively broad and the markers fall well within the required range.

Channel 6 is next aligned in the same manner. Set the receiver to channel 6, the sweep oscillator to the corresponding range, and the marker oscillator to channel 6 picture and sound carrier frequencies. Adjust L11, L12, L37, and L38 for an approximately flat-topped response curve located symmetrically between the markers.

Check channels 5 down through channel 1 by switching the receiver, sweep oscillator, and marker oscillator to each channel and observing the response obtained. In all cases, the markers should be above the 70% response point. If this is not the case, L11, L12, L37, and L38 should be retouched. On final adjustment, all channels must be within the 70% specification.

Coupling between the r-f and converter lines is augmented by a link between L12 and L37. This link is adjusted in the factory and should not require adjustment in the field. On channel 6 with the link in the minimum coupling position, the response is slightly overcoupled with an approximately 10% excursion from peak-to-valley. With the coupling at maximum, the response is somewhat broader and the peak-to-valley excursion is approximately 40%. The amount of coupling permissible is limited by the peak-to-valley excursion, which should not be greater than 30% on any channel.

R-F OSCILLATOR LINE ADJUSTMENT—The r-f oscillator line may be aligned by adjusting it to beat with a crystal calibrated heterodyne frequency meter, or by feeding a signal into the receiver at the r-f sound-carrier frequency and adjusting the oscillator for zero voltage output from the sound discriminator. In this latter case the sound discriminator must first have been aligned to exact frequency. Either method of adjustment will produce the same results. The method used will depend upon the type of test equipment available.

The heterodyne frequency meter is the more universal method since it is applicable to all types of receivers. However, it requires a great many calibration points since receivers with different intermediate frequencies employ different oscillator frequencies and hence different calibration points on the frequency meter. This may result in confusion and errors in adjustment.

Since all sets must receive the same stations, the r-f sound carrier frequencies remain the same, regardless of intermediate frequency. By use of the discriminator zeroing method, only one set of calibrating points is necessary. If these frequencies are crystal controlled, this method of alignment is very fast, with little chance for error. However, this method is applicable only on receivers that use a sound discriminator or other type of sound detector that has a definite and measurable characteristic at center frequency. This method cannot be easily employed on receivers that employ a slope type detector. Regardless of which method of oscillator alignment is used, the frequency standard must be crystal controlled or calibrated.

Both methods of oscillator alignment are presented in the alignment table. The service technician may thereby choose the method to suit his test equipment. If the dual listing is confusing, the unwanted listing can be easily crossed out.

If the receiver oscillator is to be adjusted by the heterodyne frequency meter method, the following calibration points must be established for the Model 621 TS.

Channel Number	Receiver R-F Osc. Freq. Mc
1	71
2	81
3	87
4	93
5	103
6	109
7	201
8	207
9	213
10	219
11	225
12	231
13	237

If the receiver oscillator is adjusted by feeding in the r-f sound carrier frequency, the following signals must be available.

Channel Number	R-F Sound Carrier Freq. Mc
1	49.75
2	59.75
3	65.75
4	71.75
5	81.75
6	87.75
7	179.75
8	185.75
9	191.75
10	197.75
11	203.75
12	209.75
13	215.75

If the heterodyne frequency meter method is used, couple the meter probe loosely to the receiver oscillator. If the r-f sound carrier method is used, connect the "VoltOhmyst" to the sound discriminator output (Pin 1 of V116). The order of alignment remains the same regardless of which method is used.

Since lower frequencies are obtained by adding steps of inductance, the channels must be aligned in reverse numerical order. Set the receiver station-selector switch to channel 13. Adjust the frequency standard to the correct frequency (237 mc for the heterodyne frequency meter or 215.75 mc for the signal generator). Set the fine tuning control to the middle of its range while making the adjustment.

Adjust L77 and L78 (See Figure 39 for location) for zero beat on the heterodyne frequency meter or zero voltage from the sound discriminator. The core stud extensions should be maintained equal by visual inspection except as discussed below.

Switch the receiver to channel 12, set the frequency standard to the proper frequency and adjust L76 (No. 12 in Figure 38) for the above mentioned indications. Adjust the oscillator to frequency on all channels by switching the receiver and the frequency standard to each channel and by adjusting the appropriate oscillator trimmer for the specified indication. (Channel 6 adjustment is on the side of the r-f unit. See Figure 39 for location.) Adjustment of the oscillator to the correct frequency on all channels with the fine tuning control in the middle third of its range should be possible. After the oscillator has been set on all channels, start back to channel 13 and recheck to make sure that all adjustments are correct.

If, in setting the low frequency channels, the high frequency channels are pulled noticeably off frequency, or if it is impossible to set channels 10, 11, or 12 within the range of their respective core adjustments, there may be interaction between sections of the line. A quick check can be made to determine if this is the case.

The shorting section of the r-f oscillator channel switch, (rotor) should be at ground r-f potential. If there is any dissymmetry in the circuit, the shorting section may be somewhat above ground. Since at these high frequencies, even the length of the shorting bar represents an appreciable portion of a wavelength, the lower-frequency section is effectively tapped up on the high-frequency section and reflects reactance into it. This reactance varies with low-frequency channel oscillator adjustments thus causing a shift in oscillator frequency on the upper channels. One way to cure this difficulty is to adjust the shorting switch to ground potential. This can be accomplished by staggering L77 and L78 until this condition is achieved.

To find whether or not dissymmetry exists, remove the bottom cover from the r-f unit. Set the station-selector switch to channel 10. Disconnect any input from the receiver. Connect the "VoltOhmyst" to R6 through the hole in the side of the chassis, and measure the bias on the converter grid. With an insulated metal prod, touch the center of the oscillator rotor shorting bar. A meter reading change indicates that the bar is not at r-f ground. To balance the line, switch to channel 13 and stagger the cores for one or more turns (usually L78 out and L77 in). The final adjustment must leave the oscillator on correct channel-13 frequency. Switch back to channel 10 and touch the switch rotor again. As before, meter movement indicates unbalance. For fine balancing, touch the switch contacts for channel 10. When balanced, the meter will show equal reduction for both contacts. Continue staggering the cores until balance is obtained. Then repeat the oscillator adjustments for all channels.

In later production receivers, several r-f oscillator coil changes were made and a capacitor (C19) was added to minimize the oscillator pulling effect. In receivers having C19, core staggering should not be necessary.

CONVERTER GRID TRAP ADJUSTMENT—Connect the r-f generator to the receiver antenna terminals. Observe the precaution for single-ended output generators mentioned in the r-f alignment section. Connect the oscilloscope to R6 through 10,000 ohms. Shunt the first picture i-f grid to ground with a 1,000 mmf. capacitor, keeping the leads as short as possible. Couple the marker oscillator loosely to the receiver antenna terminals. Switch the station-selector switch and the marker oscillator through the low-frequency channels and observe the response on each range. Select a channel which is essentially flat over the operating range with the sound and picture carrier markers at 90% or higher on the response curve. Remove the capacitor from the first picture i-f grid and shunt it from the second picture i-f grid to ground. Adjust C14 for an r-f response curve similar to the one obtained with the first picture i-f grid shunted.

In later production receivers, C14 is fixed and obviously this adjustment cannot be made on these sets. In such receivers, this step should be followed as a check on proper converter operation.

RETOUCHING OF PICTURE I-F ADJUSTMENTS—The picture i-f response curve varies somewhat with change of bias and for this reason the receiver should be aligned with approximately the same signal input as it will receive in operation. If the receiver is located at the edge of the service area, it should be aligned with the picture control at the maximum gain position. However, for normal conditions (signals of 800 microvolts or greater), the picture i-f stages should be aligned with a grid bias of −3 volts. Connect the sweep generator to the receiver antenna terminals. Feed in the i-f picture carrier marker of 25.75 mc and a 23 mc marker. Connect the oscilloscope across the picture-detector load resistor. Remove the shunting capacitor from the second picture i-f grid (if C14 was adjusted as outlined above). Set the i-f grid bias to −3 volts and the sweep output to produce approximately 0.3 volt peak-to-peak across the picture-detector load resistor. Observe and analyze the response curve obtained. The response may not be ideal and the i-f adjustments may have to be retouched in order to obtain the desired curve. See Figure 32.

If, for example, the response is peaked in the middle, and the picture carrier is low on the response curve slope, then L102 (which is peaked at 26 mc—near the picture carrier 25.75 mc) should be retouched to bring the picture-carrier response up to approximately 40%. The response may then be generally high on the low-frequency end of the curve. If this is the case, adjust T2 (bottom stud). Lowering the response at the low-frequency end should cause a change in the slope at the high-frequency end of the response curve. The picture carrier is thus brought still further up the slope and an approximately flat-topped response curve is obtained. If a peak or dip is encountered in the "middle" response, it can be corrected by adjusting L101 and L103.

On final adjustment the picture-carrier marker must be approximately at 60% response. The curve must be approximately flat-topped with the 23 mc marker at approximately 100% response.

The above example is used to show the line of reasoning involved in making the retouching adjustments. Since there are four coils, each aligned to a different frequency, many different conditions can exist; however, similar reasoning will apply to each case. With some experience in making these adjustments, the desired response can be readily obtained. In making these adjustments, care should be taken that no two coils are tuned to the same frequency as i-f oscillation may result.

The most important consideration in making the i-f adjustments is to get the picture carrier at the 60% response point. If the picture carrier operates too low on the response curve, loss of low-frequency video response, of picture brilliance, of blanking, and of sync may occur. If the picture carrier operates too high on the response curve, the picture definition is impaired by loss of high-frequency video response.

SENSITIVITY CHECK—A comparative sensitivity check can be made by operating the receiver on a weak signal from a television station and comparing the picture and sound obtained with that obtained on other receivers under the same conditions.

This weak signal can be obtained by connecting the shop antenna to the receiver through an attenuator pad of the type shown in Figure 31. The number of stages in the pad depends upon the signal strength available at the antenna. A sufficient number of stages should be inserted so that a somewhat less than normal contrast picture is obtained when the picture control is at the maximum clockwise position.

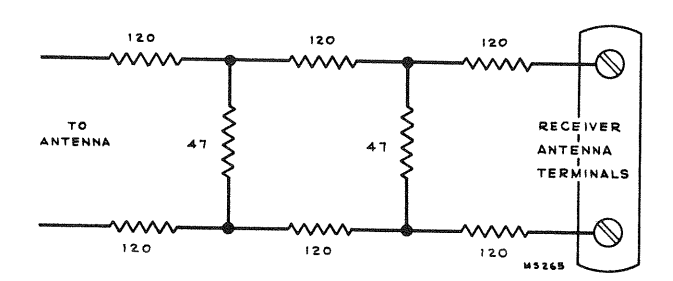


Figure 31—Attenuator Pad

Only composition type resistors should be used to construct the attenuator pad. Since many of the low-value moulded type resistors generally available are of wire-wound construction, one of each type of resistor used should be broken and examined in order to determine its construction.

RESPONSE CURVES—The response curves shown on pages 20, 21, and 22, and referred to throughout the alignment procedure, are typical, but some variations can be expected.

The response curves are shown in the classical manner of presentation; that is, with "response up" and low frequency to the left. The manner in which they will be seen in a given test set-up will depend upon the characteristics of the oscilloscope and the sweep generator. The curves may be seen inverted and/or switched from left to right depending on the deflection polarity of the oscilloscope and the phasing of the sweep generator.

ALIGNMENT PROCEDURE (Continued)

NOTE: If complete alignment is required, the sequence in which the tables appear below should be followed.

PICTURE I-F AND TRAP ADJUSTMENT (R-F Unit Must Be in Alignment for Steps 8 to 11 Inclusive)

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC	CONNECT "VOLTOHMYST" TO	CONNECT OSCILLOSCOPE TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
1	—	—	—	—	R106 to chassis	—	Set "Station Selector" switch to channel 9	Adjust "Picture" control for —3 volts reading on "VoltOhmyst"	Fig. 34
2	Converter grid (either end of R-5) in series with 1000 mmf mica capacitor	21.25 with 400 cycle modulation	Not used	—	Picture detector load resistor R118 (Pin 6 of V104)	Not used	Meter on lowest voltage range (See Note 1) Run T101 adjustment screw "out"	T2 secondary core (top stud) for minimum output	Figs. 34, 40, 33
3	"	21.25	"	—	"	"	Meter on lowest range (See Note 1)	T101 for minimum output	Fig. 33
4	"	22.8	"	—	"	"	"	T2 primary core (bottom stud) for maximum output	Fig. 34
5	"	23.9	"	—	"	"	"	L101 for maximum output	Fig. 33
6	"	26.0	"	—	"	"	"	L102 for maximum output	Fig. 33
7	"	24.5	"	—	"	"	"	L103 for maximum output	Fig. 33
8	Loosely coupled to antenna terminals	—	Antenna terminals (See Note 2)	Sweeping channel selected in "Adjust" column	Not used	Junction R6 and C14 through 10,000 ohm series resistor (See Fig. 38, page 23, for location)	Connect 1000 mmf mica capacitor from pin 1 (grid) of V101 to ground (Use short leads)	Select low-frequency channel (1 to 6), by "Station Selector," with an essentially flat response	Figs. 38, 41
9	"	See "Misc." column	"	"	"	Same as above	Adjust signal generator frequency to sound and picture R-F carriers of channel selected in step 8. Carrier "markers" must be at 90% or higher on the R-F response curve.	Select another "flat" channel if markers are not at 90% point on first channel selected. Check this channel with marker signals for desired 90% response	Alignment Table below
10	"	23 and 25.75 respectively	"	"	"	Picture detector load resistor R118 (Pin 6 of V104)	Remove 1000 mmf capacitor from pin 1 of V101 to ground	If response curve is not essentially as shown in Figure 32, with 25.75 mc marker 60% up on response curve slope, proceed with step 11	Figs. 41, 32
11	"	Same as above	"	"	"	"	Retouch adjustments on T2, L101, L102 and L103. T2 affects low-frequency response. L102 affects high-frequency response. L101 and L103 affect "middle" frequency response		Figs. 34, 33, 32

NOTE 1: Oscillation may occur if i-f section is badly out of alignment. This will be evidenced by "excessive" meter reading and is caused by the "staggered" i-f stages being tuned to approximately the same frequency. If encountered, adjust the core studs of L101, L102, and L103 until oscillation ceases. Oscillation may not be encountered until proceeding with steps 4, 5, or 6 (See "Picture I-F Oscillation," page 16).

NOTE 2: If sweep generator has "single ended" output, it will be necessary to disconnect the transmission-line jumper from the terminals adjacent to the r-f tube (V1). Feed the sweep signal in from either terminal to ground. The signal generator marker signal may then be fed into the unused terminal through a 5.6 mmf capacitor. An alternate method for connecting a "single-ended" sweep generator is to use the terminating arrangement shown in Figure 30, page 17.

Channel Number	Picture Carrier Freq. Mc	Sound Carrier Freq. Mc
1	45.25	49.75
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

Alignment Table (Carrier Frequencies)

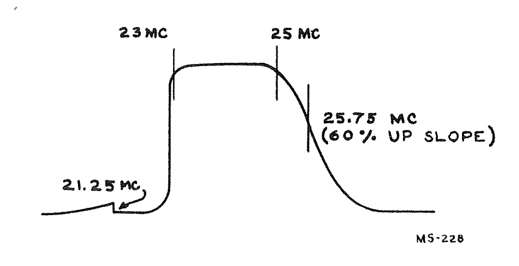


Figure 32—Typical Overall Response Curve

Note: See second paragraph of "Response Curves", page 19.

DISCRIMINATOR & SOUND I-F ALIGNMENT

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC	CONNECT "VOLTOHMYST" TO	CONNECT OSCILLOSCOPE TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
1	Grid of 2nd sound I-F tube (Pin 1 of V115)	21.25 at 1 volt output	Not used	—	In series with 1 meg. resistor to Terminal "C" of T108 (Junction of R181 and R182)	Not used	Run T108 secondary core (bottom stud) "out"	Adjust T108 primary core (top stud) for maximum output	Figs. 41, 34, 33
2	"	"	"	—	Discriminator output (Pin 1 of V116)	"	Adjust "VoltOhmyst" for "center zero" on lowest range	Adjust T108 secondary core (bottom stud) for zero d-c output	Figs. 41, 34
3	Not used	—	Grid of 2nd sound i-f tube (Pin 1 of V115)	Center freq. 21.25. Bandwidth 1 mc. Output 1 V.	Not used	Discriminator output (Pin 1 of V116)	Check for symmetrical response wave-form (positive and negative). If not equal, adjust T108 primary core (top stud) until response is essentially as shown in Figure 35 (see Note 1)		Figs. 41, 33, 35
4	"Insert" marker signal into 1st sound i-f grid circuit	21.25 with reduced output	Across T2 secondary (outside) winding. (Top of winding to chassis)	Same as above, except reduced output (See Note 2)	"	Terminal "A" of T107 ("High" end of R176)	—	Adjust T107 primary and secondary cores (top and bottom) for maximum gain and symmetry about the 21.25 mc marker. Bandwidth at 80% response should be 250 kc (See Note 3)	Figs. 40, 34, 35

NOTE 1: The peak-to-peak bandwidth of the discriminator should be approximately 350 kc and it should be linear from 21.175 mc to 21.325 mc.

NOTE 2: If a 60 cycle sweep rate is used, it will be necessary to reduce the time constant in the 2nd sound i-f grid circuit in order to reproduce the desired response curve. To do this, shunt R176 (Terminal "A" of T107 to chassis) with 5600 ohms.

NOTE 3: The sweep generator output should be set to produce approximately 0.3 volt peak-to-peak at the second sound i-f grid return (Terminal "A" of T107) for final touch-up on this adjustment. Signal voltage in excess of 0.3 volt will tend to broaden the response curve—permitting misadjustment to pass unnoticed.

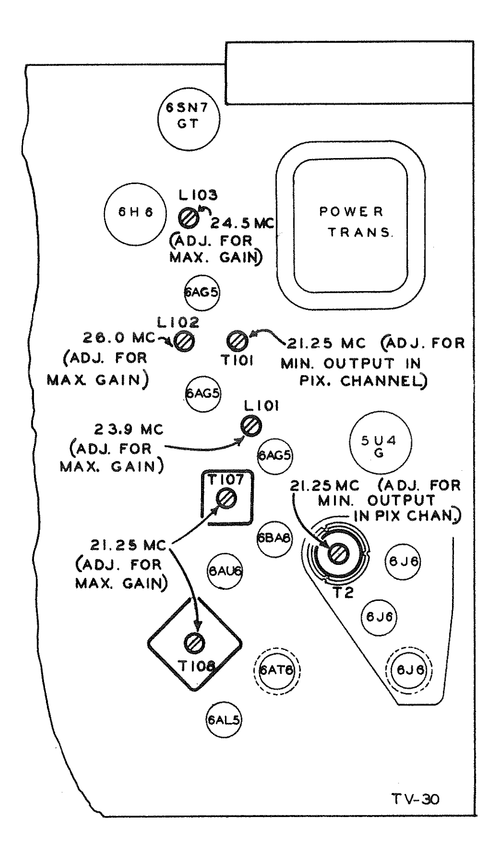


Figure 33—Top Chassis Adjustments

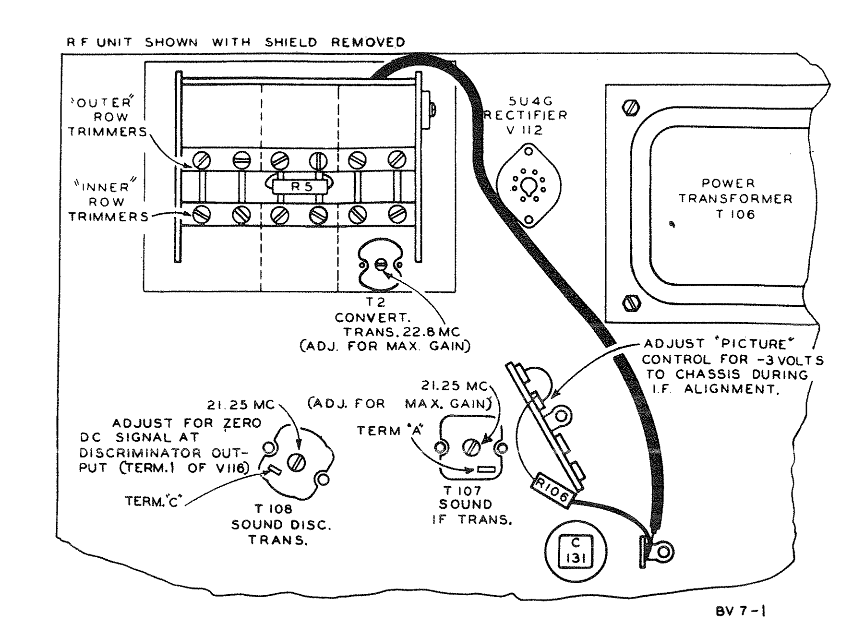


Figure 34—Bottom Chassis I-F and Discriminator Adjustments

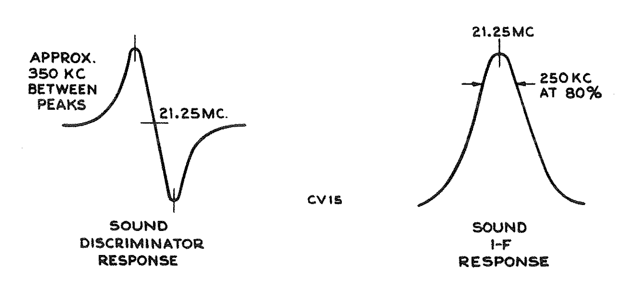


Figure 35

R-F AND CONVERTER LINE ALIGNMENT

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC	CONNECT "VOLTOHMYST" TO	CONNECT OSCILLOSCOPE TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
1	Not used		Not used		Junction of R106 and green lead from R-F unit	Not used	Set C14 1½ turns out from max. cap. (See Note)	Picture control for −1.5 volts on meter	Fig. 36
2	Antenna terminal (loosely)	175.25 & 179.75	Antenna terminals (See Note 2 under "Picture and I-F Trap Adjustment" table)	Sweeping channel 7	Not used	Junction R6 and C14through10,000 ohm series resistor (See Fig. 38 for Location)	Connect 1000 mmf mica capacitor from pin 1 (grid) of V101 to ground (Use short leads). Receiver on channel 7	L25, L26, L51 & L52 for approx. flat-top response between markers. Markers above 70%	Fig. 41 Fig. 36 Fig. 37 (7)
3	"	181.25 185.75	"	channel 8	"	"	Receiver on channel 8	Check to see that response is as above	Fig. 37 (8)
4	"	187.25 191.75	"	channel 9	"	"	Receiver on channel 9	"	Fig. 37 (9)
5	"	193.25 197.75	"	channel 10	"	"	Receiver on channel 10	"	Fig. 37 (10)
6	"	199.25 203.75	"	channel 11	"	"	Receiver on channel 11	"	Fig. 37 (11)
7	"	205.25 209.75	"	channel 12	"	"	Receiver on channel 12	"	Fig. 37 (12)
8	"	211.25 215.75	"	channel 13	"	"	Receiver on channel 13	"	Fig. 37 (13)
9	If the response on any channel (steps 3 through 8) is below 70% at either marker, switch to that channel and adjust L25, L26, L51, & L52 to pull response up on that channel. Then recheck steps 2 through 8.								
10	Antenna terminal (loosely)	83.25 87.75	Antenna terminals (See Note 2 under "Picture and I-F Trap Adjustment" table)	Sweeping channel 6	Not used	Junction R6 and C14through10,000 ohm series resistor (See Fig. 38 for Location)	Receiver on channel 6	L11, L12, L37 & L38 for response as above	Fig. 36 Fig. 37 (6)
11	"	77.25 81.75	"	channel 5	"	"	Receiver on channel 5	Check to see that response is as above	Fig. 37 (5)
12	"	67.25 71.75	"	channel 4	"	"	Receiver on channel 4	"	Fig. 37 (4)
13	"	61.25 65.75	"	channel 3	"	"	Receiver on channel 3	"	Fig. 37 (3)
14	"	55.25 59.75	"	channel 2	"	"	Receiver on channel 2	"	Fig. 37 (3)
15	"	45.25 49.75	"	channel 1	"	"	Receiver on channel 1	"	Fig. 37 (1)
16	If the response on any channel (steps 11 through 15) is below 70% at either marker, switch to that channel and adjust L11, L12, L37, & L38 to pull response up on that channel. Then recheck steps 10 through 15.								

NOTE: In most receivers, C14 is of fixed value.

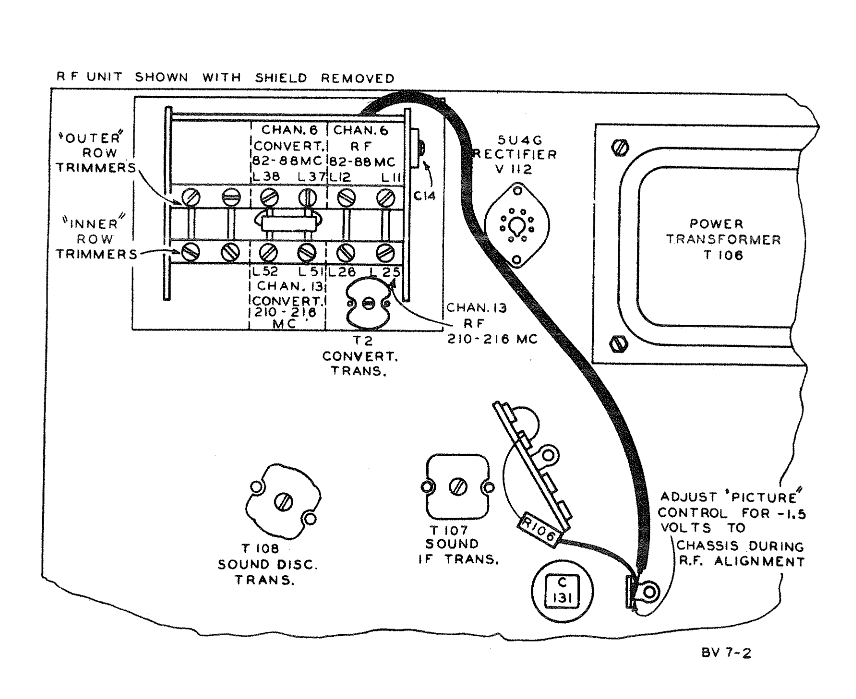


Figure 36—Bottom Chassis R-F and Converter Adjustments

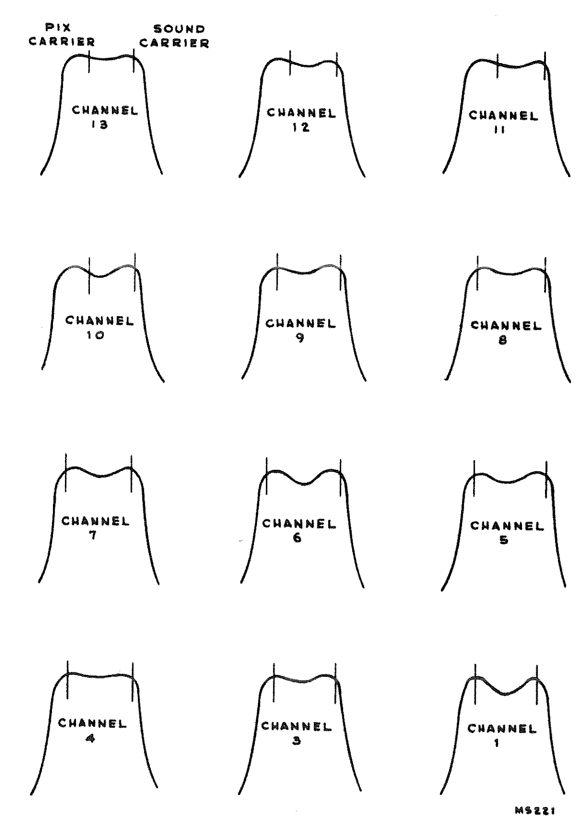


Figure 37—Typical R-F Response Curves

R-F OSCILLATOR ALIGNMENT

STEP No.	*CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC	*CONNECT "VOLTOHMYST" TO	‡CONNECT HETERODYNE FREQ. METER TO	HET. METER FREQ. MC	CONNECT OSCILLOSCOPE TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
1	Antenna terminals	215.75	Pin 1 of V-116 for sig. gen. method only	Loosely coupled to r-f osc.	237	Not used	Fine tuning centered for all adjustments Receiver on channel 13	L77 & L78 for zero on meter or beat on het. freq. meter	Fig. 41 Fig. 39
2	"	209.75	"	"	231	"	Receiver on channel 12	L76 as above (Screw 12)	Fig. 38
3	"	203.75	"	"	225	"	Receiver on channel 11	L74 as above (Screw 11)	Fig. 38
4	"	197.75	"	"	219	"	Receiver on channel 10	L72 as above (Screw 10)	Fig. 38
5	"	191.75	"	"	213	"	Receiver on channel 9	L70 as above (Screw 9)	Fig. 38
6	"	185.75	"	"	207	"	Receiver on channel 8	L68 as above (Screw 8)	Fig. 38
7	"	179.75	"	"	201	"	Receiver on channel 7	L66 as above (Screw 7)	Fig. 38
8	"	87.75	"	"	109	"	Receiver on channel 6	L63 & L64 as above	Fig. 39
9	"	81.75	"	"	103	"	Receiver on channel 5	L62 as above (Screw 5)	Fig. 38
10	"	71.75	"	"	93	"	Receiver on channel 4	L60 as above (Screw 4)	Fig. 38
11	"	65.75	"	"	87	"	Receiver on channel 3	L58 as above (Screw 3)	Fig. 38
12	"	59.75	"	"	81	"	Receiver on channel 2	L56 as above (Screw 2)	Fig. 38
13	"	49.75	"	"	71	"	Receiver on channel 1	L54 as above (Screw 1)	Fig. 38
14	Repeat steps 2 through 13 as a check.								

*Method I requires signal generator and "VoltOhmyst".
‡Method II requires heterodyne frequency meter only.

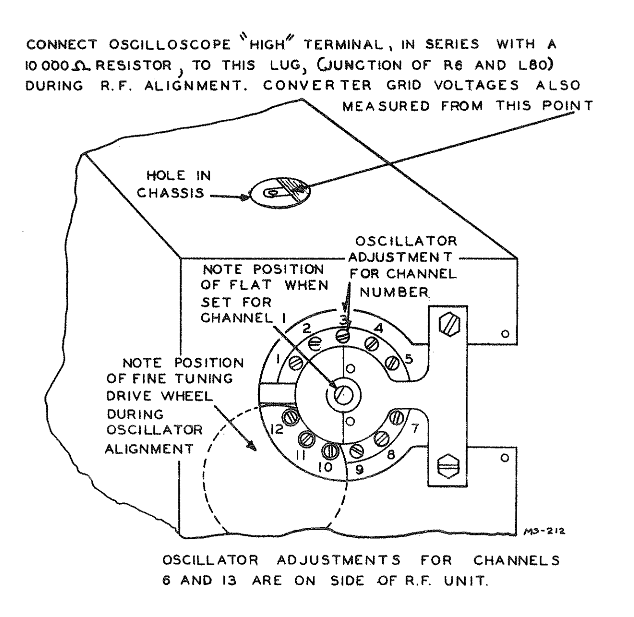


Figure 38—Front Chassis Oscillator Adjustments

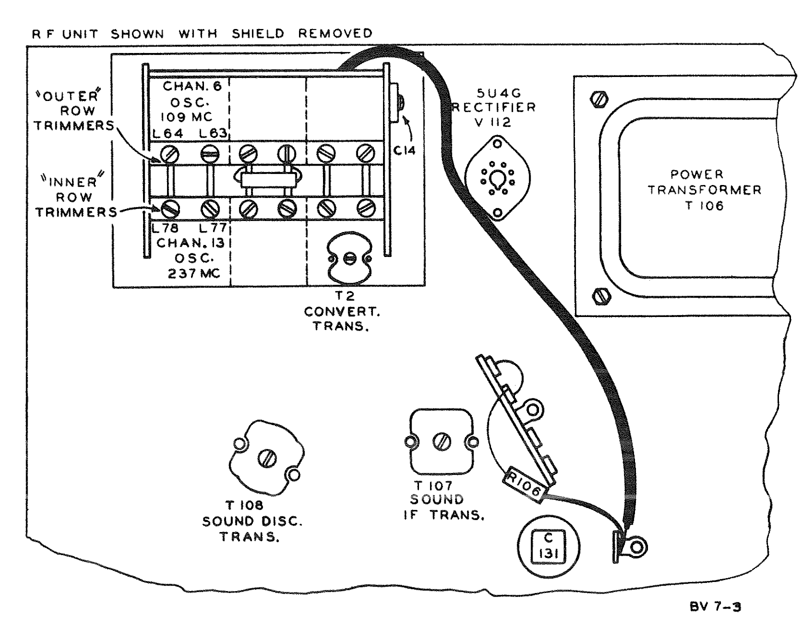
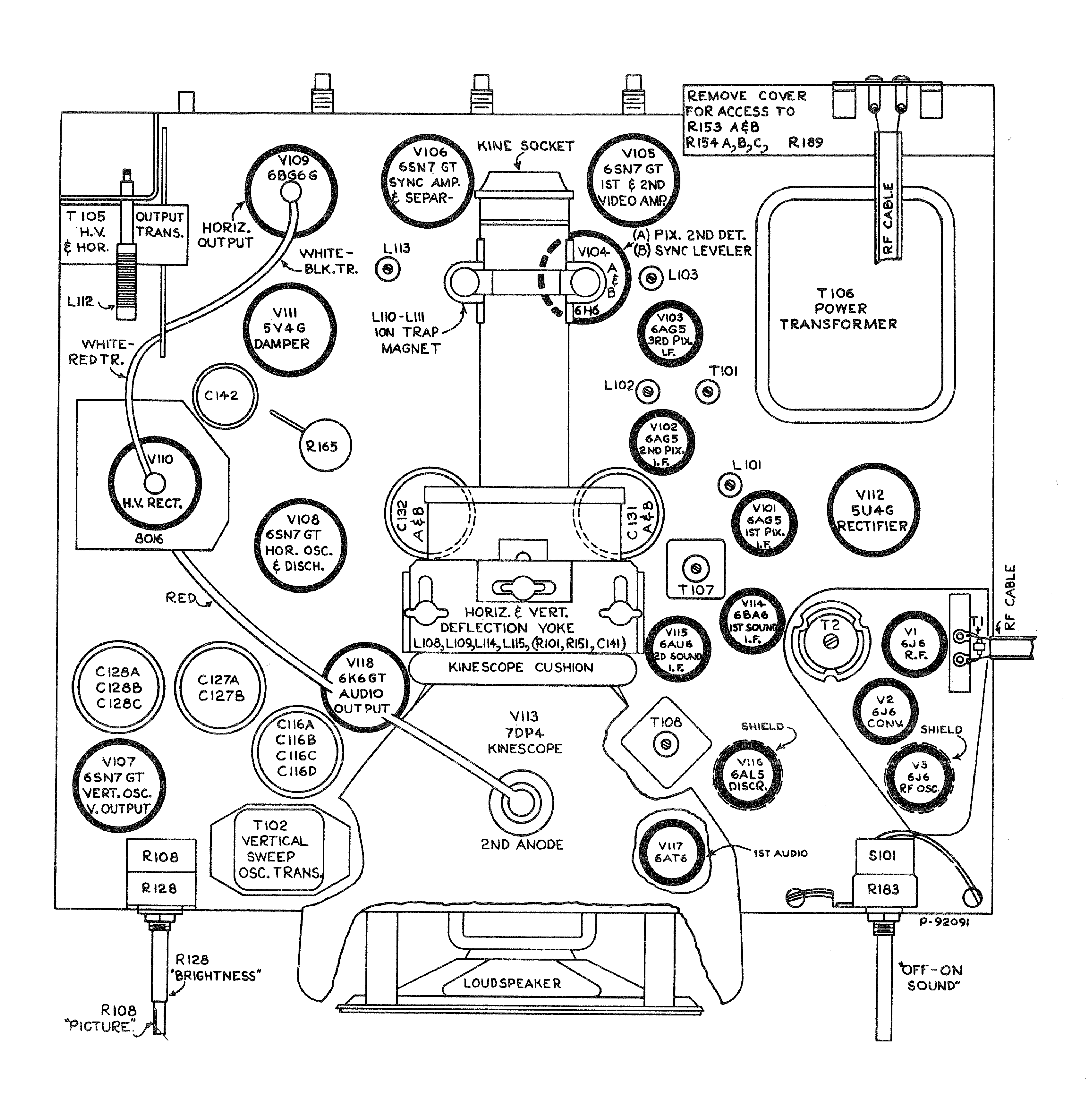


Figure 39—Bottom Chassis Oscillator Adjustments

CONVERTER GRID TRAP ADJUSTMENT (C14 in R-F Unit)

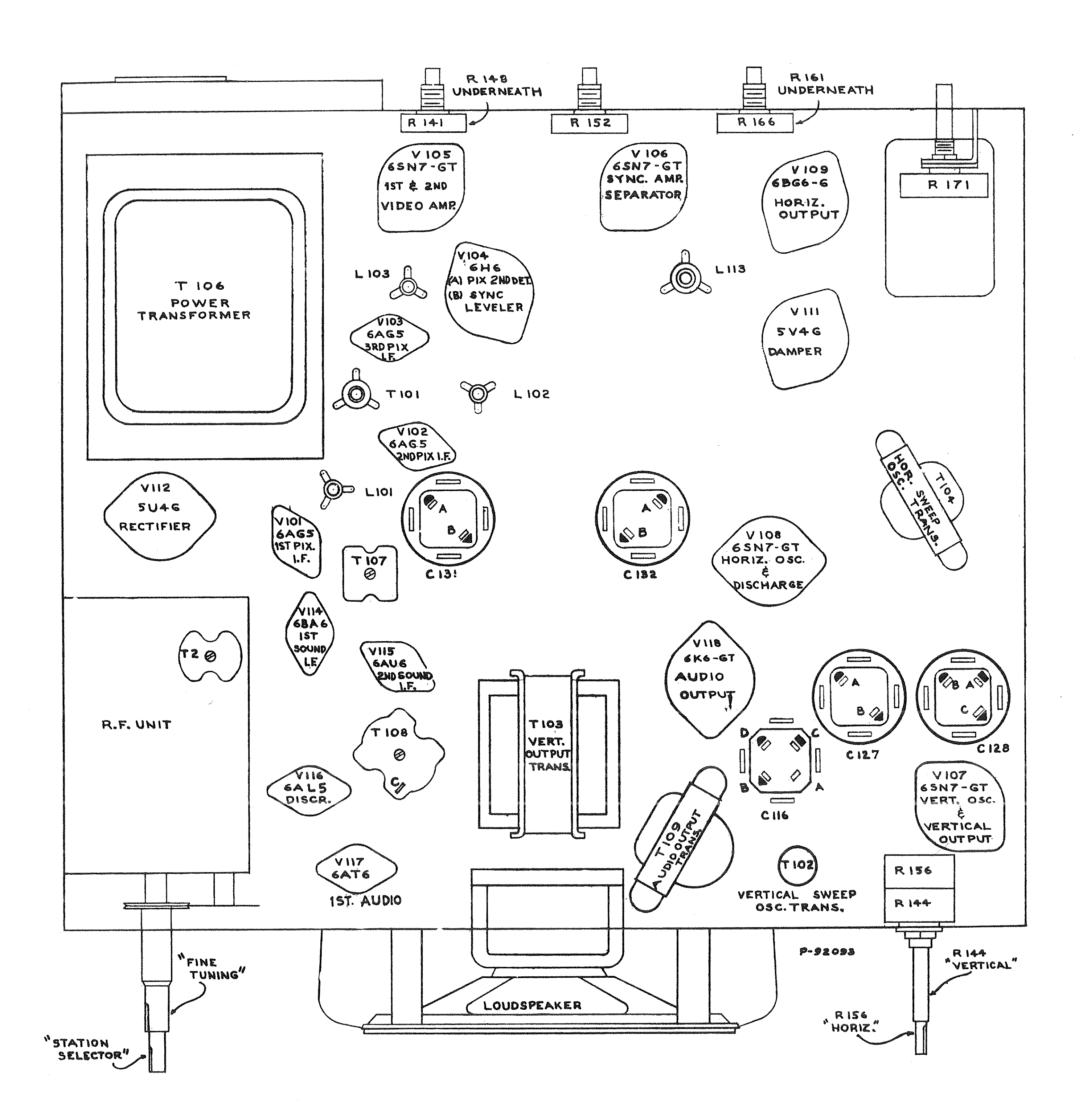
NOTE: In most receivers, C14 is of fixed value. Consequently, this adjustment will not be required.

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC	CONNECT OSCILLOSCOPE TO	MISCELLANEOUS CONNECTIONS AND ADJUSTMENTS	ADJUST	REFER TO
1	Antenna terminals (loosely)	Required markers (See Alignment Table, page 20)	Antenna terminals (See Note 2 under "Picture I-F Alignment" Table)	Sweep Channel selected under "Adjust"	Junction R6 and C14 through 10,000 ohm series resistor	Connect 1000 mmf mica capacitor from pin 1 (grid) of V101 to ground. (Use short leads)	Switch through channels 1 to 6. Select channel with flat response and markers above 90%	Figs. 38, 41
2	"		"	"	"	Move 1000 mmf capacitor from grid of V101 to grid (pin 1) of V102 to ground	Adjust C14 for response curve similar to that obtained above	Figs. 41, 39



NOTE: On some units, V116 is a 6AT6 (see schematic diagram).

Figure 40—Chassis Top View (Showing Location of Major Components)



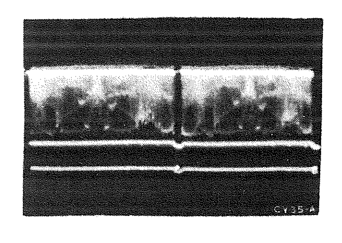
NOTE: On some units, V116 is a 6AT6 (see schematic diagram).

Figure 41—Chassis Bottom View (Showing Location of Major Components)

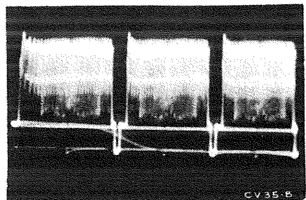
WAVEFORM PHOTOGRAPHS

Peak to peak voltages shown are nominal when 1½ volt peak to peak video signal is applied to 1st video amplifier (V105).

Video Signal Input to 1st Video Amplifier (At Pin 5 of V104A)

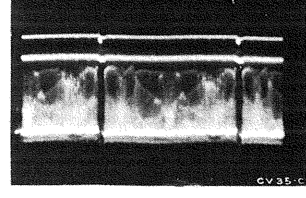


(A) Vertical (1.5 Volts, P to P)

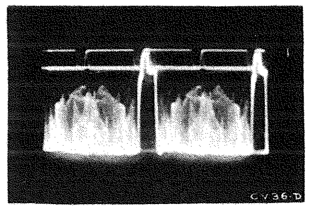


(B) Horizontal (1.5 Volts, P to P)

Output of 1st Video Amplifier (Pin 4 of V105)

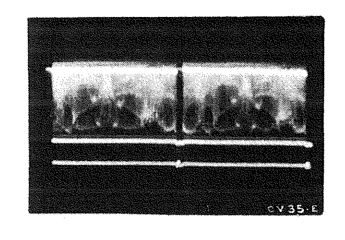


(C) Vertical (5.0 Volts, P to P)

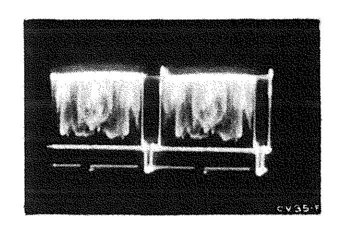


(D) Horizontal (5.0 Volts, P to P)

Input to Kinescope Grid (Junction of L106 and Green Lead to Kinescope Socket)

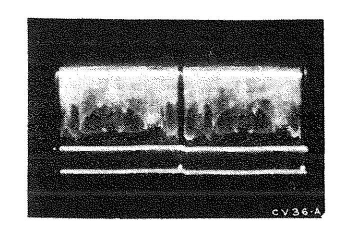


(E) Vertical (32 Volts, P to P)

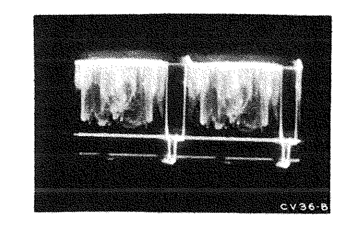


(F) Horizontal (32 Volts, P to P)

Input to Grid Sync Amplifier (Pin 1 of V106)

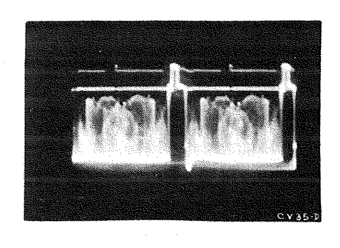


(G) Vertical (8 Volts, P to P)

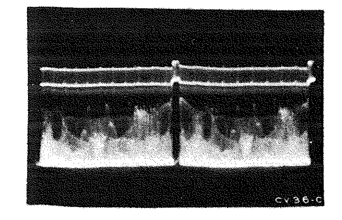


(H) Horizontal (8 Volts, P to P)

Input to Sync Separator (Pin 2 of V106)

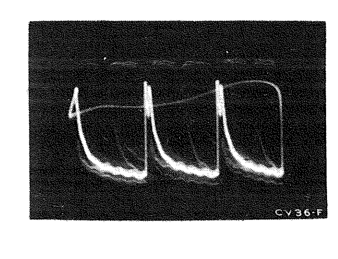


(I) Vertical (96 Volts, P to P)

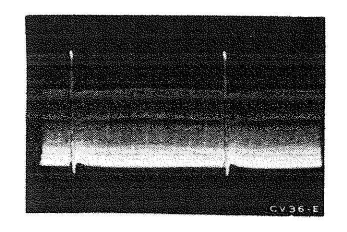


(J) Horizontal (96 Volts, P to P)

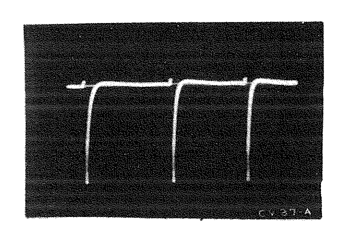
Output of Sync Separator (Pin 6 of V106)



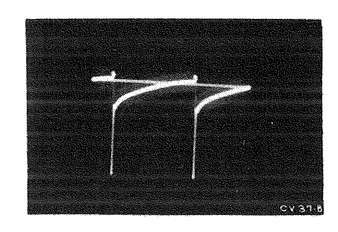
(K) Vertical (8 Volts, P to P)



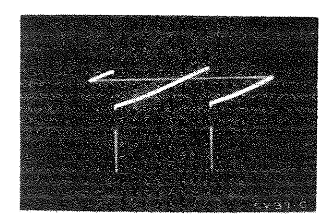
(L) Horizontal (7.5 Volts, P to P)



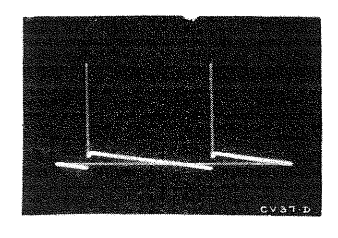
(M) Vertical (20 Volts, P to P) Output of Integrating Network (Junction of R138 and C125)



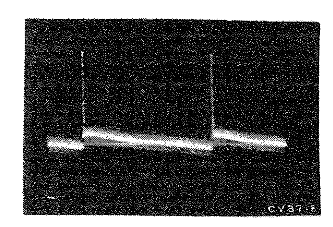
(N) Grid of Vertical Oscillator Tube (200 Volts, P to P) (Pin 1 of V107)



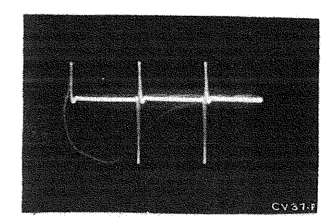
(O) Input to Vertical Output Tube (45 Volts, P to P) (Junction of C129 and C130)



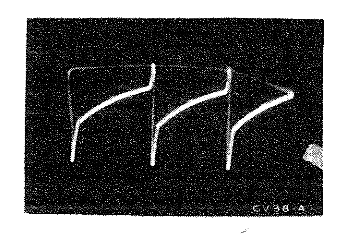
(P) Plate of Vertical Output Tube (700 Volts, P to P) (Pin 5 of V107)



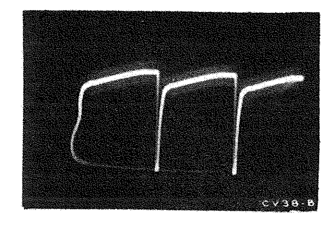
(Q) Voltage Across Vertical Deflection Coils of Yoke (L108, L109) (70 Volts, P to P) (At Green Lead of T103 to Ground)



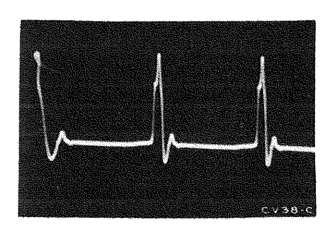
(R) Input to Horizontal Oscillator Tube (70 Volts, P to P) (Junction of R132 and R133)



(S) Grid of Horizontal Oscillator Tube (Pin 1 of V108)

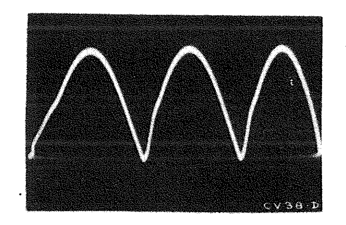


(T) Plate of Horizontal Discharge (200 Volts, P to P) (Pin 5 of V108)

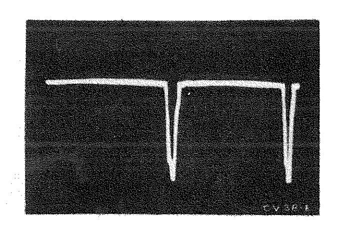


(U) Plate of Horizontal Output Tube (Approx. 5000 Volts, P to P)

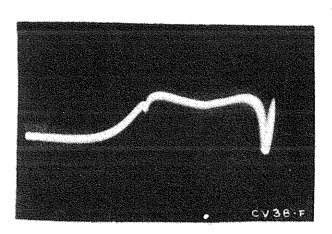
(Measured Through a Capacity Voltage Divider Connected from Top Cap of V109 to Ground)



(V) Boosted +B and Horizontal Linearity Waveform (43 Volts, P to P) (Term. 1 of T105)



(W) Voltage Across Horizontal Deflection Coils of Yoke (L114, L115) (1440 Volts, P to P) (Pins 4 or 6 of V111 to Ground)



(X) Response of 1st and 2nd Video Amplifier Stages (Marker at 3MC on Left) (Video Sweep Input to Pin 1 of V105) (Output: Pin 2 of V113 Socket) (Diode Used Had 10 mmf. Capacity)

Some of the possible troubles that may be encountered, with their effects and causes, are listed below:

NO RASTER ON KINESCOPE—The effect of no raster can be caused by the following:—

(1) Incorrect adjustment of ion trap magnet. Open coil; negative bleeder open; coils reversed.

(2) No high voltage. Check V109 (6BG6-G) and V110 (8016) tubes and circuits. If the horizontal-deflection circuits are operating, as evidenced by the correct waveform measured on terminal 4 of horizontal output transformer T105, the trouble can be isolated to the high-voltage rectifier (V110) circuit. Either the high-voltage winding (points 2 to 3 on T105) is open; the 8016 tube is defective; its filament circuit is open; or the high-voltage filter capacitor C142 is shorted.

(3) Damper tube (V111, 5V4-G) inoperative. Plate voltage supply for 6BG6-G horizontal output tube is obtained through the damper tube. Check tube, and heater winding on T106. If tube is O.K., check L113 (horizontal linearity coil) for continuity, and capacitors C139 and C140 for short circuit.

(4) Defective Kinescope. Heater open; cathode "return" circuit open.

(5) No plate voltage. Shorted electrolytic capacitor; open speaker field coil. All +B measurements are accessible for measurement by removing cover from bleeder box located below antenna terminals. (See Figures 40 and 44.)

(6) Horizontal osc. and discharge tube (V108, 6SN7-GT) inoperative. Check for sawtooth on grid of horizontal output tube (V109, 6BG6-G). If not present, check waveforms, voltages, and components in V108 circuits.

HORIZONTAL DEFLECTION ONLY—If horizontal deflection only is obtained, evidenced by a "straight line" across the face of the Kinescope, it can be caused by the following:

(1) Vertical oscillator and output tube (V107, 6SN7-GT) inoperative. Check waveforms and voltages on grid and plate.

(2) Vertical output transformer (T103) open.

(3) Vertical yoke open.

POOR VERTICAL LINEARITY—If adjustment of the vertical height and linearity controls will not correct this condition, any of the following may be the cause:

(1) Vertical output transformer (T103) defective.

(2) Capacitors C128-C or C127-B defective.

(3) V107 (6SN7-GT) defective. Check waveforms and voltages.

(4) Excess leakage or incorrect value in capacitor C130.

(5) Low plate and bias voltages. Check rectifier tube and capacitors in +B supply circuits.

(6) Capacitor C129 defective or incorrect in value.

POOR HORIZONTAL LINEARITY—If adjustment of controls does not correct this condition, check the following:

(1) Check or replace horizontal output tube (V109, 6BG6-G).

(2) Check or replace damper tube (V111, 5V4-G).

(3) Check waveform on grid of V109.

(4) Check linearity coil L113 for short circuit.

(5) Check capacitors C139 and C140 for defects or incorrect values.

(6) Check R165 for incorrect value or open circuit.

TRAPEZOIDAL OR NON-SYMMETRICAL RASTER—This condition can be caused by:

Defective yoke.

WRINKLES ON LEFT SIDE OF RASTER—This condition can be caused by:

Defective yoke due to R101, R151, or C141 (internal in yoke assembly) being wrong value or open. These components are mounted in rear of yoke assembly.

SMALL RASTER—This condition can be caused by:

(1) Low +B or line voltage.

(2) Insufficient output from horizontal output tube V109 (6BG6-G). Replace tube.

RASTER—NO IMAGE, BUT ACCOMPANYING SOUND—This condition can be caused by:

(1) No signal on Kinescope grid. Check picture i-f amplifier tubes V101 (6AG5), V102 (6AG5), V103 (6AG5), second detector V104 (6H6), and video amplifier V105 (6SN7-GT).

(2) Bad contact to kinescope grid. (Lead to socket broken.)

SIGNAL APPEARS ON KINESCOPE GRID BUT IS UNABLE TO SYNCHRONIZE THE PICTURE VERTICALLY AND HORIZONTALLY—A condition of this nature can be caused by:

(1) Defective sync amplifier and separator tube (V106, 6SN7-GT).

(2) If tube is O.K., check voltages, waveforms and associated circuits.

SIGNAL ON KINESCOPE GRID AND HORIZONTAL SYNC ONLY—If this condition is encountered, check:

Vertical integrating network capacitors C122, C123, C124, C125, and resistors R136, R137, R138.

PICTURE STABLE BUT WITH POOR RESOLUTION—If the picture resolution is not up to standard, it may be caused by any of the following:

(1) Sub-standard picture detector tube (V104, 6H6) or video amplifier tube (V105, 6SN7-GT).

(2) Open video peaking coil. Check all peaking coils (L104, L105, L106, L107) for continuity. Note that L105 and L106 have shunting resistors.

(3) Leakage in V105 grid capacitor C115.

If above components are not found to be defective, check the following:—

(1) Check all potentials in video circuits.

(2) Check Kinescope grid circuit for poor or dirty contact.

(3) Check adjustment of focus control (R171). It should be effective on either side of proper focus.

(4) Check and realign, if necessary, the picture i-f and r-f circuits.

PICTURE SMEAR—This trouble can originate in either the transmitter or the receiver. Check reception from another station. Normally, smear can be attributed to phase shift at the low-frequency end of the video characteristic. This can be caused by improper values of R and C in the video circuits. Check for grid current on video amplifier tube V105.

PICTURE JITTER—

(1) If regular sections at the left of the picture are displaced, replace the horizontal output tube (V109, 6BG6-G).

(2) Vertical instability may be due to loose connections or "noise" received with the signal.

(3) Horizontal instability may be due to unstable transmitted sync, or to "noise."

CRITICAL LEAD DRESS

Dress speaker field leads away from 6K6-GT (V118) socket and behind vertical output transformer T103.

Dress blue lead of vertical output transformer away from V118 socket.

Dress plate leads of 6BG6-G (V109) and 8016 (V110) tubes away from each other and away from width-control (L112) coil.

Twist leads from width-control (L112) coil.

Dress leads from horizontal hold control (R156) away from leads from vertical hold control (R144).

Keep leads from i-f transformers short.

In replacing components that have a connection to chassis ground, be certain to make ground connection to same chassis lance that was used in original factory wiring.

If replacement of horizontal output and high voltage transformer (T105) is required, check lead dress to be sure maximum spacing between leads is maintained, as shown in Figure 42.

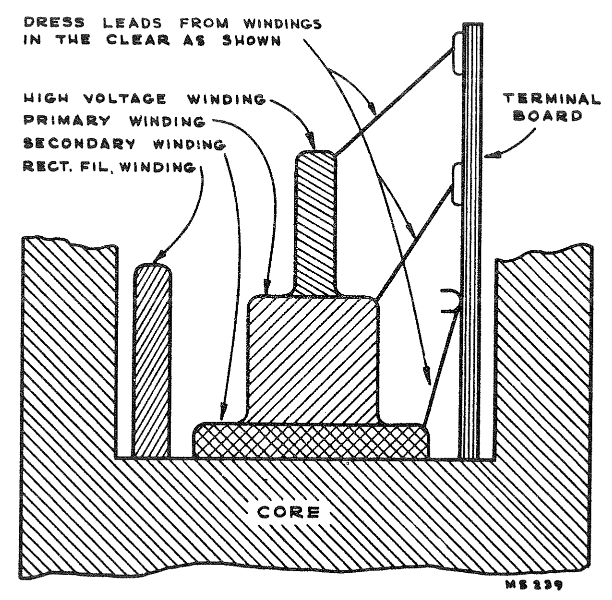


Figure 42—T105 Lead Dress

NOTES

Modification of the synch circuit has been made in some receivers installed in low signal areas.

Modification # 1

C 119 is 100 mmf., R 134 is 3.9 meg. and is connected to chassis grd. instead of to — 20 — volts.

Modification # 2

A -1 meg. resistor has been added from pin #3 of V-104B to chassis grd.

Antenna Wave Trap:

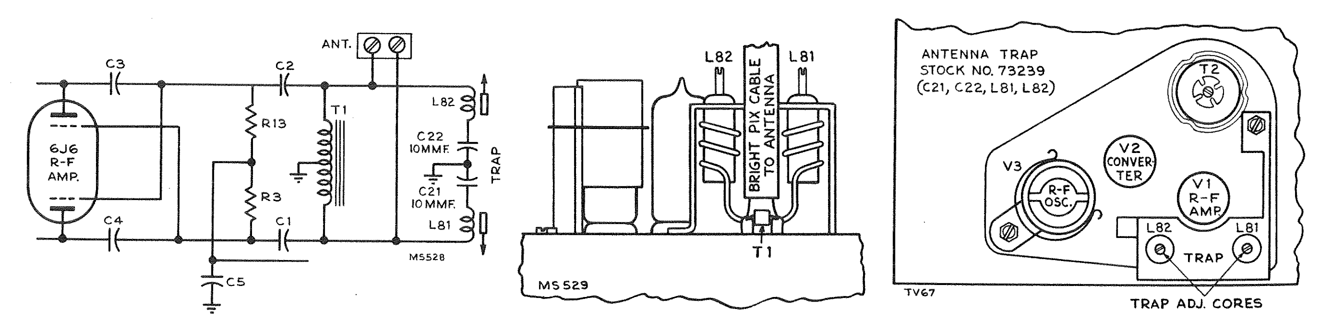
In some instances interference may be encountered from FM stations that are on the image frequency of a television station. In other instances interference between two television stations may be observed.

Assume that two television stations in a city are operating on channels 6 and 10. When the receiver is tuned to channel 6, a small amount of the oscillator voltage (109 mc.) is present on the r-f amplifier grid. This 109 mc. voltage beats with the channel 10 picture carrier and produces an 84.25 mc. signal. This signal falls within the channel 6 range and interferes with the reception of channel 6. A similar case occurs between channels 5 and 7.

A series resonant trap across the r-f amplifier grid circuit will remove the oscillator voltage from the grids and will minimize this type of interference. Such a trap was installed on those receives which experienced this type of interference.

To adjust the trap, tune in the station on which the interference is observed. Tune both cores of the trap for minimum interference in the picture. Keep both cores approximately equal. Turn one core ½ turn from the original position, then readjust the second core for minimum interference in the picture. Repeat until the best rejection is obtained. For shop alignment the cores of this trap should be run out before proceeding with r-f and converter line adjustment. After the receiver alignment is completed, the trap should be retuned.

The illustrations below illustrate the schematic diagram and location of the trap.



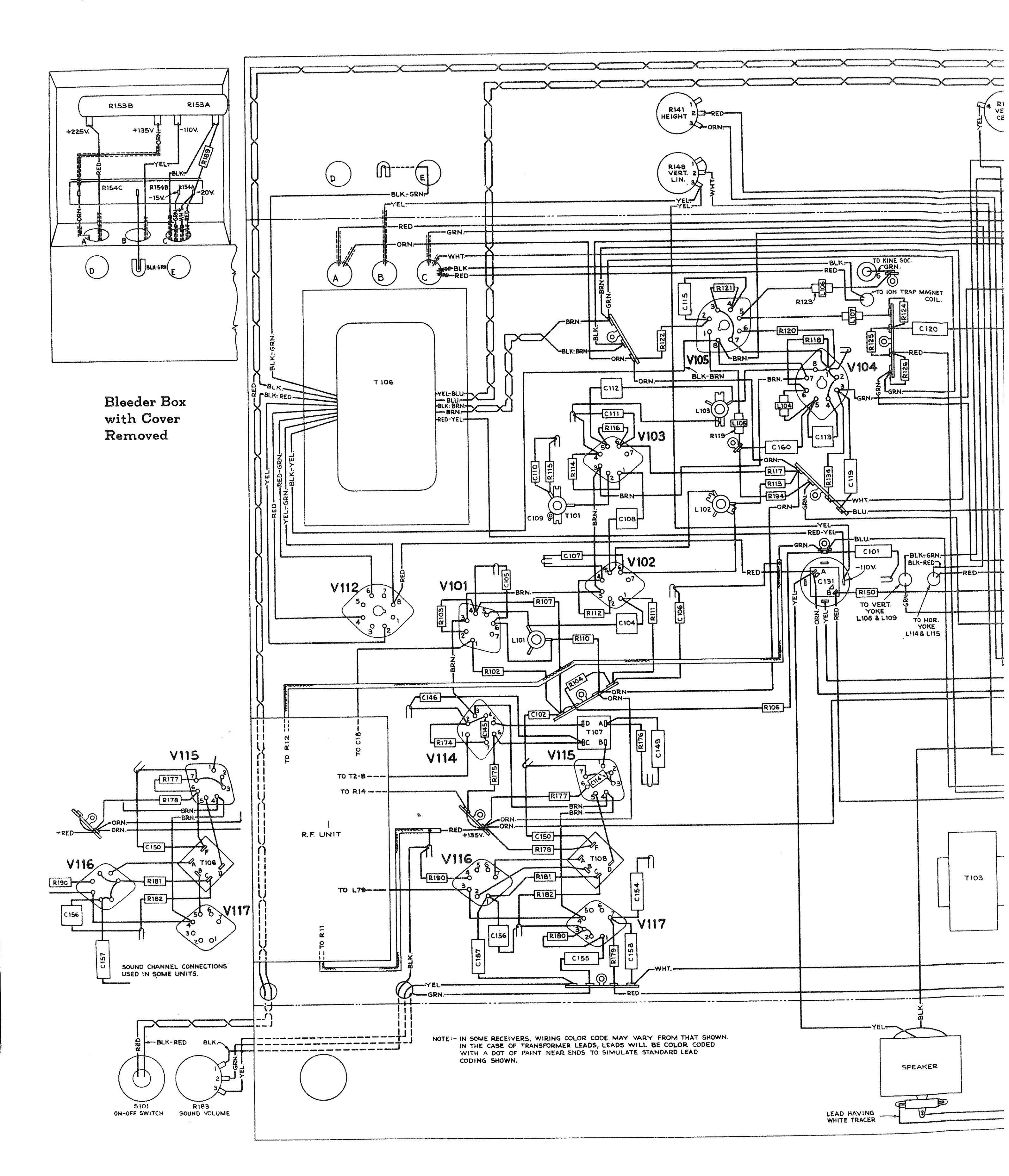
R-F UNIT WIRING DIAGRAM

NOTE: In some R-F Units, capacitor C14 is a variable trimmer and is connected between L80 and ground. L80 is connected to R6.

NOTE: In some units the tap on T2 is one turn lower than shown here.

NOTE: Capacitor C19 is not used in some R-F Units.

Figure 43—R-F Unit Wiring Diagram


R153B
R153A
+225V.
+135V
-110V.
R189
R154C
R154B
R154A
-15V.
-20V.
Bleeder Box with Cover Removed
R141 HEIGHT
R148 VERT. LIN.
T 106
TO KINE SOC.
TO ION TRAP MAGNET COIL.
V105
V104
V103
V102
V101
V112
V114
V115
V116
V117
T101
T107
T108
T103
L101
L102
L103
L104
L105
L106
L107
C131
TO VERT. YOKE L108 & L109
TO HOR. YOKE L114 & L115
TO R12
TO C18
TO T2-B
TO R14
R.F. UNIT
TO L79
TO R11
SOUND CHANNEL CONNECTIONS USED IN SOME UNITS.
S101 ON-OFF SWITCH
R183 SOUND VOLUME
NOTE:- IN SOME RECEIVERS, WIRING COLOR CODE MAY VARY FROM THAT SHOWN. IN THE CASE OF TRANSFORMER LEADS, LEADS WILL BE COLOR CODED WITH A DOT OF PAINT NEAR ENDS TO SIMULATE STANDARD LEAD CODING SHOWN.
SPEAKER
LEAD HAVING WHITE TRACER

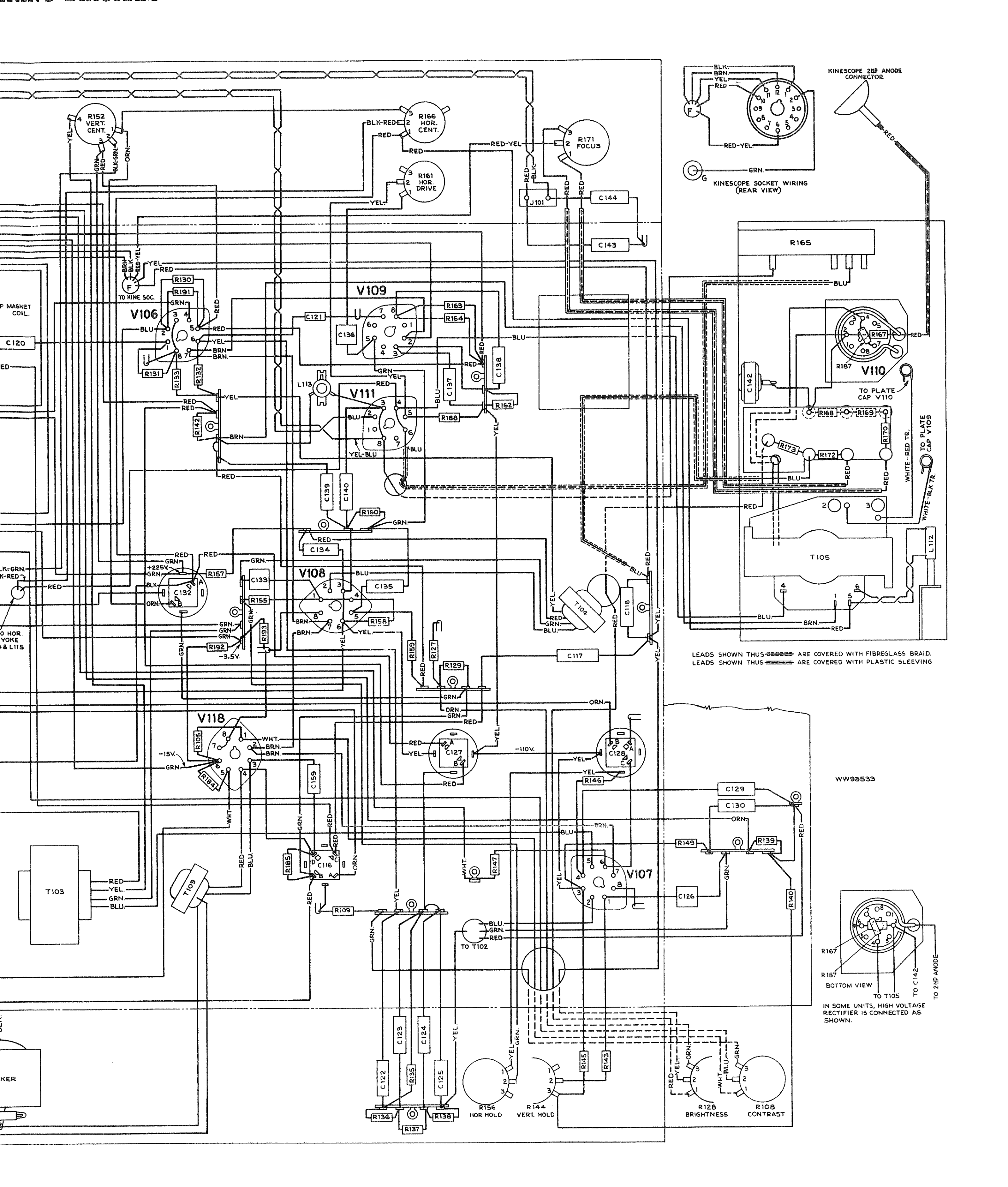
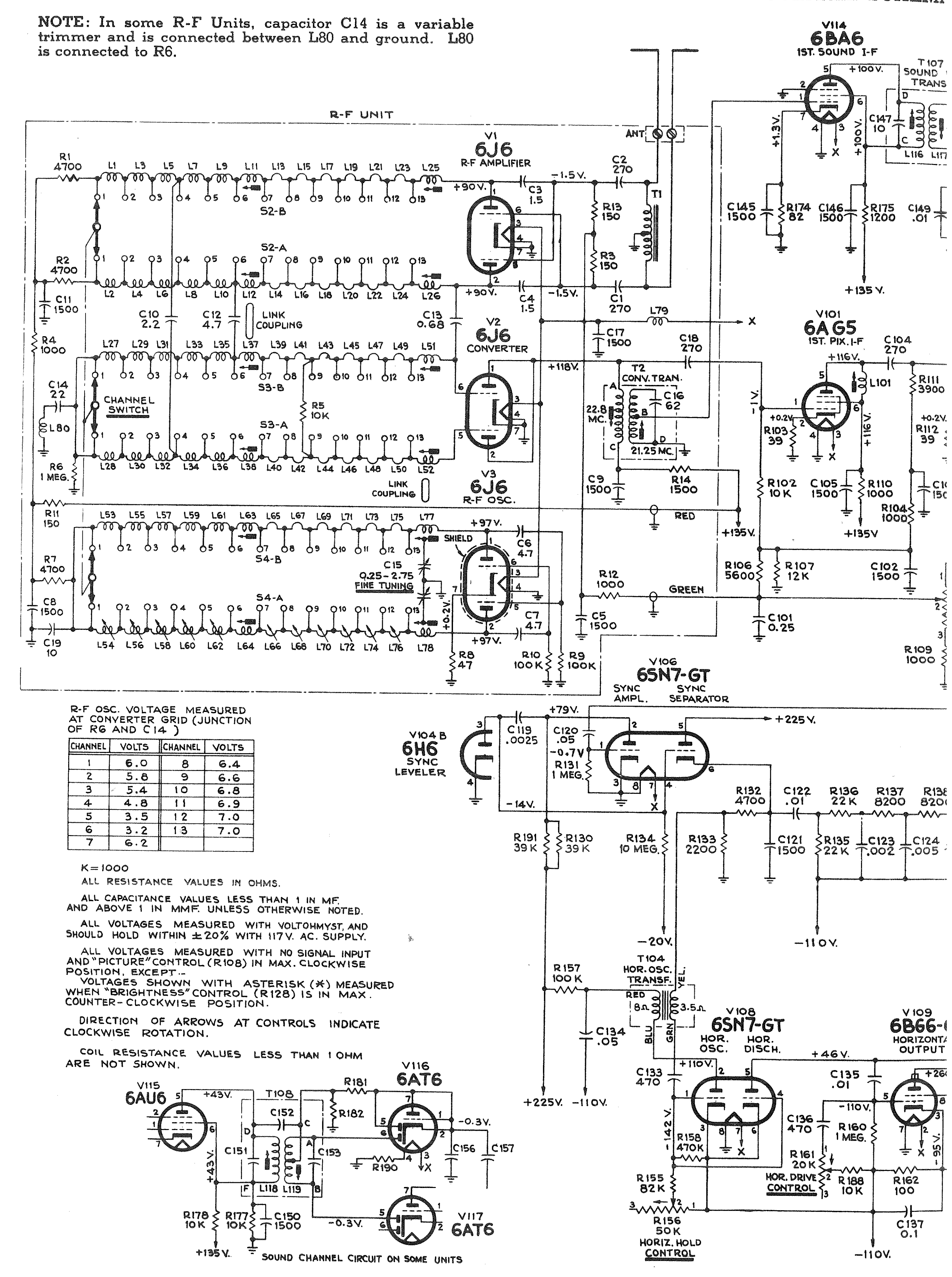


Figure 44—Chassis Wiring Diagram

STOCK No.	DESCRIPTION
	R-F UNIT ASSEMBLY
71504	Capacitor—Ceramic, 0.68 mmf. (C13)
71500	Capacitor—Ceramic, 1.5 mmf. (C3, C4)
71502	Capacitor—Ceramic, 2.2 mmf. (C10)
71520	Capacitor—Ceramic, 4.7 mmf. (C6, C7, C12)
45466	Capacitor—Ceramic, 10 mmf. (C19)
33101	Capacitor—Ceramic, 22 mmf. (C14)
65401	Capacitor—Mica, 270 mmf. (C18)
71540	Capacitor—Ceramic, 270 mmf. (C1, C2)
71501	Capacitor—Ceramic, 1500 mmf. (C5, C8, C9, C11, C17)
72122	Coil—Channel #1 front and rear converter grid coil and channel #1 front and rear r-f amplifier plate coil (L1, L2, L27, L28)
71469	Coil—Channel #1 front or rear oscillator coil (L53, L54)
71480	Coil—Channel #4 front and rear r-f amplifier plate coils (L7, L8)
71470	Coil—Channel #2 front, channel #3 front, or channel #4 front oscillator coil (L56, L58, L60)
71479	Coil—Channel #2 front and rear r-f amplifier coils, channel #4 front and rear converter grid coils, channel #2 front and rear, channel #3 front and rear r-f amplifier plate coils (L3, L4, L5, L6, L29, L30, L33, L34)
72597	Coil—Channel #3 front and rear converter grid coils (L31, L32)
72552	Coil—Channel #3 rear oscillator coil (L57)
72553	Coil—Channel #4 rear oscillator coil (L59)
71472	Coil—Channel #5 rear oscillator coil (L61)
71481	Coil—Channel #5 front and rear converter grid coils, channel #5 front and rear r-f amplifier coils (L9, L10, L35, L36)
71471	Coil—Channel #2 rear or channel #5 front oscillator coil (L55, L62)
71492	Coil—Channel #6 front and rear oscillator converter grid and r-f amplifier plate coils (L11, L12, L37, L38, L63, L64)
71488	Coil—Channel #13 front oscillator coil (L78)
71489	Coil—Channel #13 rear oscillator coil (L77)
71490	Coil—Channel #13 front converter grid or r-f amplifier plate coil (L26, L52)
71491	Coil—Channel #13 rear converter grid or r-f amplifier plate coil (L25, L51)
71506	Coil—Converter grid trap coil (L80)
71505	Coil—Heater choke coil (L79)
71493	Connector—Segment connector
71497	Core—Channel #6 oscillator coil adjustable core
71498	Core—Channels #6 and #13 converter grid and r-f amplifier coils adjustable core
71597	Core—Channel #13 oscillator coils adjustable core
71463	Detent—R-F unit detent mechanism and fibre shaft
71465	Disc—Rotor disc for fine tuning stator (Part of C15)
71464	Drive—Fine tuning pinch washer drive
71487	Form—Coil form only for channels #6 and #13 coils —less winding
71462	Loop—Oscillator to converter grid coupling loop
30732	Resistor—47 ohms, ½ watt (R8)
30880	Resistor—150 ohms, ½ watt (R3, R11, R13)
34766	Resistor—1000 ohms, ½ watt (R4, R12, R14)
30494	Resistor—4700 ohms, ½ watt (R1, R2, R7)
3078	Resistor—10,000 ohms, ½ watt (R5)
3252	Resistor—100,000 ohms, ½ watt (R9, R10)
30652	Resistor—1 megohm, ½ watt (R6)
14343	Ring—Retainer ring for drive
71475	Screw— #4-40 x .296 adjusting screw for coils L54, L56, L58, , L60, L62
71476	Screw— #4-40 x ¼" binder head screw for adjusting coils (L66, L68, L70, L72, L74, L76)
71473	Segment—Converter grid and r-f amplifier plate front section's segment less coils (Part of S2, S3)
71474	Segment—Converter grid, and r-f amplifier plate section's segment less coils (Part of S2, S3)
71467	Segment—Oscillator section front segment less coils (Part of S4)
71468	Segment—Oscillator section rear segment less coils (Part of S4)
71494	Socket—Tube socket, miniature
71461	Spring—Snap spring to hold fine tuning shaft and disc
71466	Stator—Oscillator fine tuning stator and bushing (Part of C15)
71507	Transformer—Antenna transformer (T1)
72811	Transformer—Converter transformer (stamped 970144-4) (T2, C16)

STOCK No.	DESCRIPTION
	CHASSIS ASSEMBLIES KCS 21-1
71894	Bearing—Bearing for r-f unit shaft
71460	Board—"Antenna" board
71791	Cable—R-F cable
66646	Capacitor—Mica, 10 mmf. (C113)
45469	Capacitor—Ceramic, 100 mmf. (C110)
65401	Capacitor—Mica, 270 mmf. (C104, C108, C112, C156)
65399	Capacitor—Mica, 470 mmf. (C133, C136)
71450	Capacitor—Ceramic, 500 mmf. (C142)
71501	Capacitor—Ceramic, 1500 mmf. (C102, C105, C106, C107, C111, C114, C121, C145, C146, C150)
72524	Capacitor—Mica, 4700 mmf. (C126)
71436	Capacitor—Electrolytic comprising 1 section of 250 mfd., 10 volts and 1 section of 1000 mfd., 6 volts (C132A, C132B)
70601	Capacitor—Tubular, .002 mfd., 200 volts (C123)
70602	Capacitor—Tubular, .0025 mfd., 400 volts (C119, C154, C155)
70606	Capacitor—Tubular, .005 mfd., 400 volts (C124, C125, C159)
70610	Capacitor—Tubular, .01 mfd., 200 volts (C122, C135, C149, C157, C158)
71770	Capacitor—Tubular, .01 mfd., 400 volts (C143, C144)
71518	Capacitor—Oil, impregnated, .035 mfd., 600 volts (C139)
70615	Capacitor—Tubular, .05 mfd., 400 volts (C115, C120, C134, C138, C160)
70638	Capacitor—Tubular, 0.1 mfd., 600 volts (C140)
71912	Capacitor—Tubular, 0.1 mfd., 200 volts (C130)
70617	Capacitor—Tubular, 0.1 mfd., 400 volts (C117, C118, C137)
70618	Capacitor—Tubular, 0.25 mfd., 200 volts (C101, C129)
71779	Capacitor—Electrolytic comprising 1 section of 40 mfd., 300 volts, 1 section of 20 mfd., 300 volts, 1 section of 10 mfd., 300 volts and 1 section of 40 mfd., 250 volts (C116A, C116B, C116C, C116D)
71780	Capacitor—Electrolytic comprising 1 section of 80 mfd., 450 volts and 1 section of 10 mfd., 450 volts (C127A, C127B)
71781	Capacitor—Electrolytic comprising 1 section of 40 mfd., 450 volts, 1 section of 40 mfd., 150 volts and 1 section of 130 mfd., 50 volts (C128A, C128B, C128C)
71782	Capacitor—Electrolytic comprising 1 section of 40 mfd., 450 volts and 1 section of 10 mfd., 350 volts (C131A, C131B)
71778	Coil—Cathode trap coil (T101, C109)
71449	Coil—Horizontal linearity coil (L113)
71793	Coil—Peaking coil (L104, L107)
71528	Coil—Peaking coil (L106, R123)
71529	Coil—Peaking coil (L105, R119)
71429	Coil—Width control coil (L112)
71789	Connector—Anode connector
71521	Contact—Hi-voltage capacitor lead contact
71784	Control—Brightness, picture control (R108, R128)
71788	Control—Focus control (R171)
71440	Control—Height control (R141)
71447	Control—Horizontal drive control (R161)
71441	Control—Vertical linearity control (R148)
71443	Control—Vertical or horizontal centering control (R152, R166)
71445	Control—Vertical and horizontal hold control (R144, R156)
71785	Control—Volume control and power switch (R183, S101)
71457	Cord—Power cord and plug
71437	Cover—Insulating cover for electrolytic capacitors, #'s 71780 and 71781
71783	Cover—Insulating cover for electrolytic capacitors, #'s 71436 and 71437
71509	Cushion—Deflection yoke hood upper cushion
71510	Cushion—Deflection yoke hood lower cushion
71451	Nut—Speed nut to mount hi-voltage capacitor
18469	Plate—Bakelite mounting plate for electrolytic capacitors #'s 71436, 71780, 71781, and 71782
71448	Plug—2 prong male plug for power cable
72066	Resistor—2.2 ohms, ⅓ watt (R187)
72067	Resistor—5.1 ohms, ½ watt (R190)
11956	Resistor—39 ohms, ½ watt (R103, R112)
30732	Resistor—47 ohms, ½ watt (R120)
71992	Resistor—56 ohms, 1 watt (R189)
13961	Resistor—82 ohms, ½ watt (R174)
70715	Resistor—100 ohms, 1 watt (R162)

NOTE: In some R-F Units, capacitor C14 is a variable trimmer and is connected between L80 and ground. L80 is connected to R6.



R-F OSC. VOLTAGE MEASURED AT CONVERTER GRID (JUNCTION OF R6 AND C14)

CHANNEL	VOLTS	CHANNEL	VOLTS
1	6.0	8	6.4
2	5.8	9	6.6
3	5.4	10	6.8
4	4.8	11	6.9
5	3.5	12	7.0
6	3.2	13	7.0
7	6.2		

K=1000

ALL RESISTANCE VALUES IN OHMS.

ALL CAPACITANCE VALUES LESS THAN 1 IN MF. AND ABOVE 1 IN MMF. UNLESS OTHERWISE NOTED.

ALL VOLTAGES MEASURED WITH VOLTOHMYST, AND SHOULD HOLD WITHIN ±20% WITH 117V. AC. SUPPLY.

ALL VOLTAGES MEASURED WITH NO SIGNAL INPUT AND "PICTURE" CONTROL (R108) IN MAX. CLOCKWISE POSITION, EXCEPT.-
VOLTAGES SHOWN WITH ASTERISK (*) MEASURED WHEN "BRIGHTNESS" CONTROL (R128) IS IN MAX. COUNTER-CLOCKWISE POSITION.

DIRECTION OF ARROWS AT CONTROLS INDICATE CLOCKWISE ROTATION.

COIL RESISTANCE VALUES LESS THAN 1 OHM ARE NOT SHOWN.

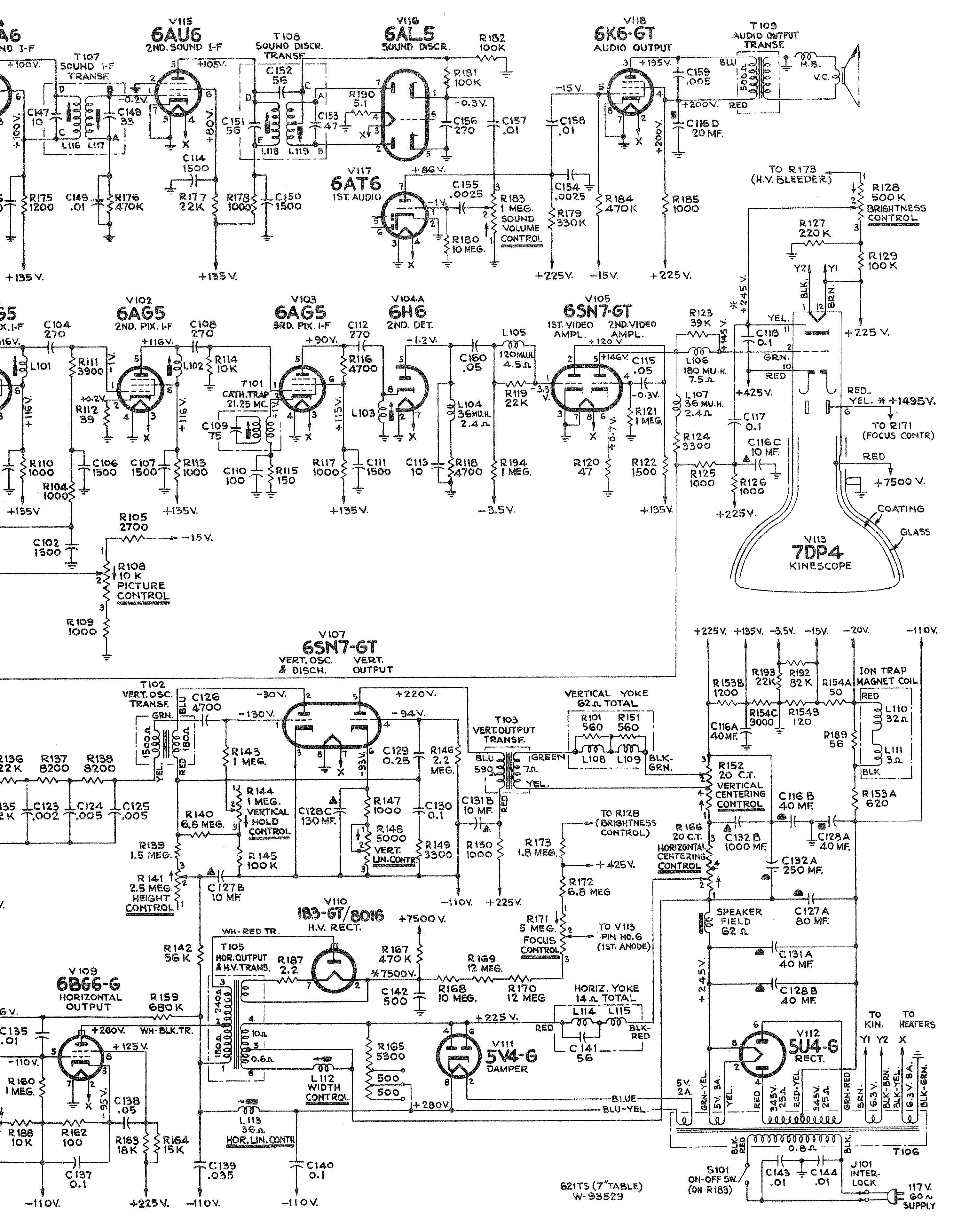


Figure 45—Overall Circuit Schematic Diagram

LL SCHEMATIC DIAGRAM

621TS

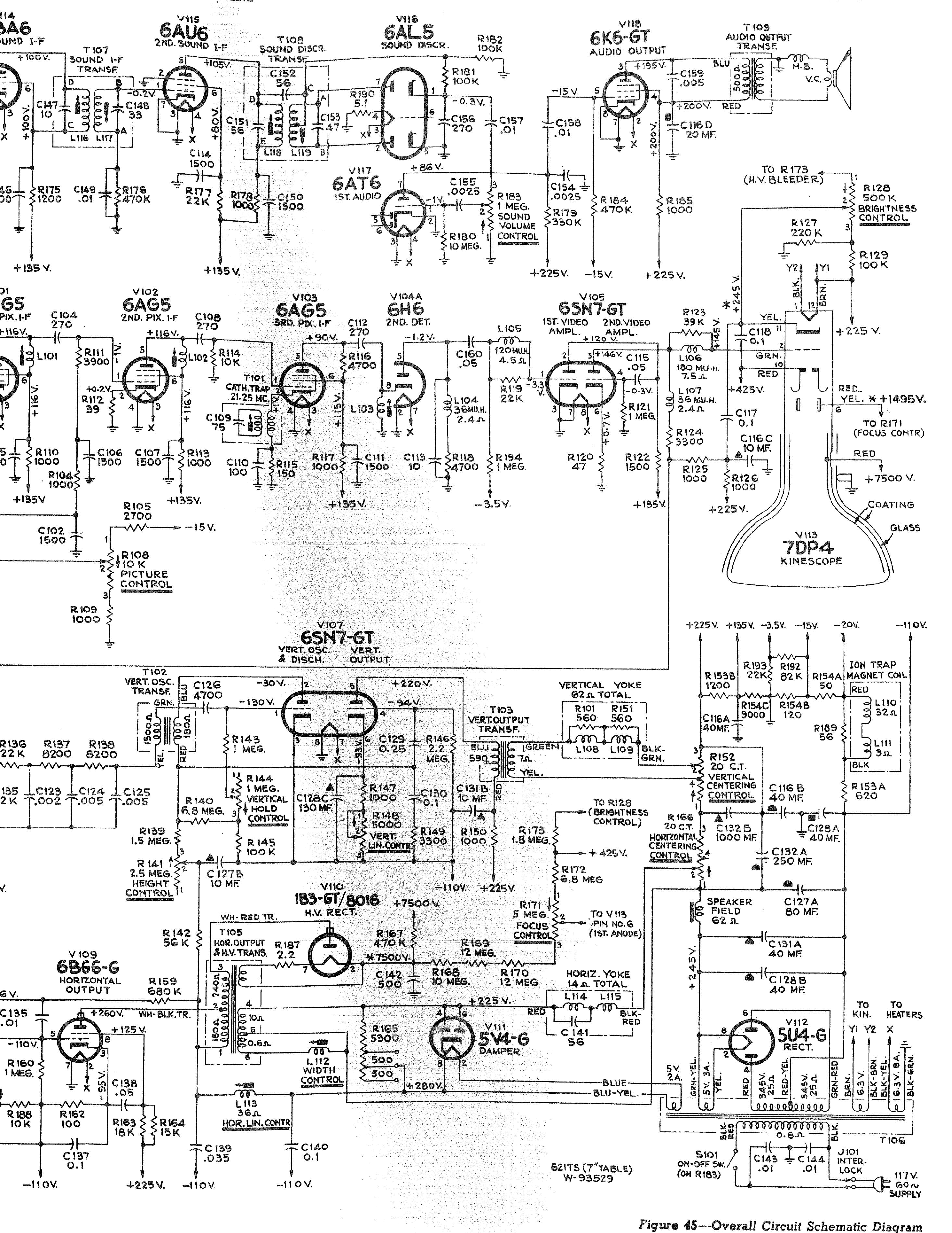


Figure 45—Overall Circuit Schematic Diagram

STOCK No.	DESCRIPTION
	R-F UNIT ASSEMBLY
71504	Capacitor—Ceramic, 0.68 mmf. (C13)
71500	Capacitor—Ceramic, 1.5 mmf. (C3, C4)
71502	Capacitor—Ceramic, 2.2 mmf. (C10)
71520	Capacitor—Ceramic, 4.7 mmf. (C6, C7, C12)
45466	Capacitor—Ceramic, 10 mmf. (C19)
33101	Capacitor—Ceramic, 22 mmf. (C14)
65401	Capacitor—Mica, 270 mmf. (C18)
71540	Capacitor—Ceramic, 270 mmf. (C1, C2)
71501	Capacitor—Ceramic, 1500 mmf. (C5, C8, C9, C11, C17)
72122	Coil—Channel #1 front and rear converter grid coil and channel #1 front and rear r-f amplifier plate coil (L1, L2, L27, L28)
71469	Coil—Channel #1 front or rear oscillator coil (L53, L54)
71480	Coil—Channel #4 front and rear r-f amplifier plate coils (L7, L8)
71470	Coil—Channel #2 front, channel #3 front, or channel #4 front oscillator coil (L56, L58, L60)
71479	Coil—Channel #2 front and rear r-f amplifier coils, channel #4 front and rear converter grid coils, channel #2 front and rear, channel #3 front and rear r-f amplifier plate coils (L3, L4, L5, L6, L29, L30, L33, L34)
72597	Coil—Channel #3 front and rear converter grid coils (L31, L32)
72552	Coil—Channel #3 rear oscillator coil (L57)
72553	Coil—Channel #4 rear oscillator coil (L59)
71472	Coil—Channel #5 rear oscillator coil (L61)
71481	Coil—Channel #5 front and rear converter grid coils, channel #5 front and rear r-f amplifier coils (L9, L10, L35, L36)
71471	Coil—Channel #2 rear or channel #5 front oscillator coil (L55, L62)
71492	Coil—Channel #6 front and rear oscillator converter grid and r-f amplifier plate coils (L11, L12, L37, L38, L63, L64)
71488	Coil—Channel #13 front oscillator coil (L78)
71489	Coil—Channel #13 rear oscillator coil (L77)
71490	Coil—Channel #13 front converter grid or r-f amplifier plate coil (L26, L52)
71491	Coil—Channel #13 rear converter grid or r-f amplifier plate coil (L25, L51)
71506	Coil—Converter grid trap coil (L80)
71505	Coil—Heater choke coil (L79)
71493	Connector—Segment connector
71497	Core—Channel #6 oscillator coil adjustable core
71498	Core—Channels #6 and #13 converter grid and r-f amplifier coils adjustable core
71597	Core—Channel #13 oscillator coils adjustable core
71463	Detent—R-F unit detent mechanism and fibre shaft
71465	Disc—Rotor disc for fine tuning stator (Part of C15)
71464	Drive—Fine tuning pinch washer drive
71487	Form—Coil form only for channels #6 and #13 coils —less winding
71462	Loop—Oscillator to converter grid coupling loop
30732	Resistor—47 ohms, ½ watt (R8)
30880	Resistor—150 ohms, ½ watt (R3, R11, R13)
34766	Resistor—1000 ohms, ½ watt (R4, R12, R14)
30494	Resistor—4700 ohms, ½ watt (R1, R2, R7)
3078	Resistor—10,000 ohms, ½ watt (R5)
3252	Resistor—100,000 ohms, ½ watt (R9, R10)
30652	Resistor—1 megohm, ½ watt (R6)
14343	Ring—Retainer ring for drive
71475	Screw—#4-40 x .296 adjusting screw for coils L54, L56, L58, , L60, L62
71476	Screw—#4-40 x ¼" binder head screw for adjusting coils (L66, L68, L70, L72, L74, L76)
71473	Segment—Converter grid and r-f amplifier plate front section's segment less coils (Part of S2, S3)
71474	Segment—Converter grid, and r-f amplifier plate section's segment less coils (Part of S2, S3)
71467	Segment—Oscillator section front segment less coils (Part of S4)
71468	Segment—Oscillator section rear segment less coils (Part of S4)
71494	Socket—Tube socket, miniature
71461	Spring—Snap spring to hold fine tuning shaft and disc
71466	Stator—Oscillator fine tuning stator and bushing (Part of C15)
71507	Transformer—Antenna transformer (T1)
72811	Transformer—Converter transformer (stamped 970144-4) (T2, C16)

STOCK No.	DESCRIPTION
	CHASSIS ASSEMBLIES KCS 21-1
71894	Bearing—Bearing for r-f unit shaft
71460	Board—"Antenna" board
71791	Cable—R-F cable
66646	Capacitor—Mica, 10 mmf. (C113)
45469	Capacitor—Ceramic, 100 mmf. (C110)
65401	Capacitor—Mica, 270 mmf. (C104, C108, C112, C156)
65399	Capacitor—Mica, 470 mmf. (C133, C136)
71450	Capacitor—Ceramic, 500 mmf. (C142)
71501	Capacitor—Ceramic, 1500 mmf. (C102, C105, C106, C107, C111, C114, C121, C145, C146, C150)
72524	Capacitor—Mica, 4700 mmf. (C126)
71436	Capacitor—Electrolytic comprising 1 section of 250 mfd., 10 volts and 1 section of 1000 mfd., 6 volts (C132A, C132B)
70601	Capacitor—Tubular, .002 mfd., 200 volts (C123)
70602	Capacitor—Tubular, .0025 mfd., 400 volts (C119, C154, C155)
70606	Capacitor—Tubular, .005 mfd., 400 volts (C124, C125, C159)
70610	Capacitor—Tubular, .01 mfd., 200 volts (C122, C135, C149, C157, C158)
71770	Capacitor—Tubular, .01 mfd., 400 volts (C143, C144)
71518	Capacitor—Oil, impregnated, .035 mfd., 600 volts (C139)
70615	Capacitor—Tubular, .05 mfd., 400 volts (C115, C120, C134, C138, C160)
70638	Capacitor—Tubular, 0.1 mfd., 600 volts (C140)
71912	Capacitor—Tubular, 0.1 mfd., 200 volts (C130)
70617	Capacitor—Tubular, 0.1 mfd., 400 volts (C117, C118, C137)
70618	Capacitor—Tubular, 0.25 mfd., 200 volts (C101, C129)
71779	Capacitor—Electrolytic comprising 1 section of 40 mfd., 300 volts, 1 section of 20 mfd., 300 volts, 1 section of 10 mfd., 300 volts and 1 section of 40 mfd., 250 volts (C116A, C116B, C116C, C116D)
71780	Capacitor—Electrolytic comprising 1 section of 80 mfd., 450 volts and 1 section of 10 mfd., 450 volts (C127A, C127B)
71781	Capacitor—Electrolytic comprising 1 section of 40 mfd., 450 volts, 1 section of 40 mfd., 150 volts and 1 section of 130 mfd., 50 volts (C128A, C128B, C128C)
71782	Capacitor—Electrolytic comprising 1 section of 40 mfd., 450 volts and 1 section of 10 mfd., 350 volts (C131A, C131B)
71778	Coil—Cathode trap coil (T101, C109)
71449	Coil—Horizontal linearity coil (L113)
71793	Coil—Peaking coil (L104, L107)
71528	Coil—Peaking coil (L106, R123)
71529	Coil—Peaking coil (L105, R119)
71429	Coil—Width control coil (L112)
71789	Connector—Anode connector
71521	Contact—Hi-voltage capacitor lead contact
71784	Control—Brightness, picture control (R108, R128)
71788	Control—Focus control (R171)
71440	Control—Height control (R141)
71447	Control—Horizontal drive control (R161)
71441	Control—Vertical linearity control (R148)
71443	Control—Vertical or horizontal centering control (R152, R166)
71445	Control—Vertical and horizontal hold control (R144, R156)
71785	Control—Volume control and power switch (R183, S101)
71457	Cord—Power cord and plug
71437	Cover—Insulating cover for electrolytic capacitors, #'s 71780 and 71781
71783	Cover—Insulating cover for electrolytic capacitors, #'s 71436 and 71437
71509	Cushion—Deflection yoke hood upper cushion
71510	Cushion—Deflection yoke hood lower cushion
71451	Nut—Speed nut to mount hi-voltage capacitor
18469	Plate—Bakelite mounting plate for electrolytic capacitors #'s 71436, 71780, 71781, and 71782
71448	Plug—2 prong male plug for power cable
72066	Resistor—2.2 ohms, ⅓ watt (R187)
72067	Resistor—5.1 ohms, ½ watt (R190)
11956	Resistor—39 ohms, ½ watt (R103, R112)
30732	Resistor—47 ohms, ½ watt (R120)
71992	Resistor—56 ohms, 1 watt (R189)
13961	Resistor—82 ohms, ½ watt (R174)
70715	Resistor—100 ohms, 1 watt (R162)

REPLACEMENT PARTS

STOCK No.	DESCRIPTION
30880	Resistor—150 ohms, ½ watt (R115)
71916	Resistor—1000 ohms, 1 watt (R178, R185)
34766	Resistor—1000 ohms, ½ watt (R104, R109, R110, R113, R117, R125, R126, R147, R150)
30731	Resistor—1200 ohms, ½ watt (R175)
30654	Resistor—1500 ohms, ½ watt (R122)
34767	Resistor—2200 ohms, ½ watt (R133)
30730	Resistor—2700 ohms, ½ watt (R105)
71986	Resistor—3300 ohms, 1 watt (R124)
30733	Resistor—3300 ohms, ½ watt (R149)
30694	Resistor—3900 ohms, ½ watt (R111)
30494	Resistor—4700 ohms, ½ watt (R116, R118, R132)
30734	Resistor—5600 ohms, ½ watt (R106)
14250	Resistor—8200 ohms, ½ watt (R137, R138)
3078	Resistor—10,000 ohms, ½ watt (R102, R114, R188)
30436	Resistor—12,000 ohms, ½ watt (R107)
70723	Resistor—15,000 ohms, 1 watt (R164)
18757	Resistor—18,000 ohms, 1 watt (R163)
30492	Resistor—22,000 ohms, ½ watt (R135, R136, R177, R193)
71084	Resistor—39,000 ohms, 1 watt (R130, R191)
30650	Resistor—56,000 ohms, ½ watt (R142)
8064	Resistor—82,000 ohms, ½ watt (R155, R192)
3252	Resistor—100,000 ohms, ½ watt (R129, R145, R157, R181, R182)
14583	Resistor—220,000 ohms, ½ watt (R127)
14983	Resistor—330,000 ohms, ½ watt (R179)
30648	Resistor—470,000 ohms, ½ watt (R158, R176, R184)
72521	Resistor—470,000 ohms, 1 watt (R167)
30562	Resistor—680,000 ohms, ½ watt (R159)
71786	Resistor—Wire wound comprising 1 section of 1200 ohms, 8 watt and 1 section of 620 ohms, 10 watt (R153A, R153B)
71787	Resistor—Voltage divider, comprising 1 section of 9000 ohms, 2.5 watt, 1 section of 120 ohms, 2 watt and 1 section of 50 ohms, 1 watt (R154A, R154B, R154C)
71439	Resistor—Wire wound resistor comprising 1 section of 5300 ohms, 20 watt and 2 sections of 500 ohms, 2 watt (R165)
30652	Resistor—1 megohm, ½ watt (R121, R131, R143, R160, R194)
31449	Resistor—1.5 megohms, ½ watt (R139)
39063	Resistor—1.8 megohms, 1 watt (R173)
30649	Resistor—2.2 megohms, ½ watt (R146)
31071	Resistor—6.8 megohms, ½ watt (R140)
72523	Resistor—6.8 megohms, 2 watt (R172)
30992	Resistor—10 megohms, ½ watt (R134, R180)
31107	Resistor—10 megohms, 2 watt (R168)
72522	Resistor—12 megohms, 2 watt (R169, R170)
71456	Screw—Wing screw for deflection yoke
71790	Socket—Kinescope socket
71508	Socket—Tube socket, octal, for 8016 tube
72516	Socket—Tube socket, miniature, 7 contact for 6AU6 and 6BA6 tubes
36500	Socket—Tube socket, miniature, 7 contact
31251	Socket—Tube socket, octal, 8 contact
71559	Spring—Grounding spring for hi-voltage capacitor
71426	Transformer—First, second or third picture i-f transformer (L101, L102, L103)
71427	Transformer—Sound discriminator transformer (T108, L118, L119, C151, C152, C153)
71776	Transformer—Audio output transformer (T109)
71416	Transformer—Hi-voltage transformer (T105)
71773	Transformer—Horizontal oscillator transformer (T104)
71772	Transformer—Power transformer, 110 volts, 60 cycle (T106)
71424	Transformer—Sound i-f transformer (T107, L116, L117, C147, C148)

STOCK No.	DESCRIPTION
71775	Transformer—Vertical oscillator transformer (T102)
71774	Transformer—Vertical output transformer (T103)
71792	Trap—Ion trap magnet (L110, L111)
71777	Yoke—Deflection yoke (L108, L109, L114, L115, R101, R151, C141)
	SPEAKER ASSEMBLY 92565-1W
71797	Speaker—6" x 4" elliptical E.M. speaker complete
	NOTE: If stamping on speaker in instrument does not agree with above speaker number, order replacement parts by referring to model number of instrument, number stamped on speaker and full description of part required.
	MISCELLANEOUS
72427	Back—Cabinet back
72431	Bracket—Safety glass upper bracket
72432	Bracket—Safety glass lower bracket
X1625	Cloth—Grille cloth
72429	Decal—"Off-on Sound and Station Selector" decal for walnut and standard mahogany cabinets
72428	Decal—"Picture-Brightness and Horizontal-Vertical" decal for walnut and standard mahogany cabinets
72823	Decal—Control panel decal ("Off-On Sound and Station Selector" and "Picture Brightness and Horizontal-Vertical" decal for toasted mahogany cabinets)
71984	Decal—Trade mark decal
71598	Escutcheon—Channel marker escutcheon
72433	Felt—Safety glass felt (2 required)
72113	Foot—Rubber foot for cabinet (4 required)
72430	Glass—Safety glass
71534	Knob—Channel selector knob (outer) for walnut or standard mahogany instruments
72568	Knob—Channel selector knob (outer) for toasted mahogany instruments
71536	Knob—Horizontal hold or contrast control knob (inner) for walnut or standard mahogany instruments
72569	Knob—Horizontal hold or contrast control knob (inner) for toasted mahogany instruments
71533	Knob—Fine tuning knob (inner) for walnut or standard mahogany instruments
72567	Knob—Fine tuning knob (inner) for toasted mahogany instruments
71535	Knob—Sound volume and power switch, vertical hold or brightness control knob (outer) for walnut or standard mahogany instruments
72565	Knob—Sound volume and power switch, vertical hold or brightness control knob (outer) for toasted mahogany instruments
71537	Knob—Sound volume and power switch knob (inner) for walnut or standard mahogany instruments
72566	Knob—Sound volume and power switch knob (inner) for toasted mahogany instruments
71538	Spring—Spring clip for escutcheon
14270	Spring—Retaining spring for knob, #'s 71534, 71535, 71537, 72565, 72566 and 72568.
4982	Spring—Retaining spring for knob, #'s 71533 and 72567
30330	Spring—Retaining spring for knob, #'s 71536 and 72569
71539	Support—Support slide with rubber cushion for kinescope (4 required)

NOTE: On those units utilizing the sound channel circuit shown in the lower left corner of the schematic diagram, the following parts list changes are effective:

Stock No. 71495—Transformer—Converter transformer (stamped 970144-2) (T2, C16) is used in place of Stock No. 72811 Transformer.

C114 is not used.

R178 is Stock No. 71914—Resistor, 10,000 ohms, 1 watt.

R177 is same as R102.

Stock No. 72516—Socket—Tube socket, miniature, 7 contact for 6AU6 and 6BA6 tubes—is not used.

APPLY TO YOUR RCA DISTRIBUTOR FOR PRICES OF REPLACEMENT PARTS